ENGINEERING NEWS

THE first month's work on the Hudson river tunnel has advanced the heading of the north tunnel 60 ft. the average progress during the last week being 3 ft. each day. This is very satisfactory, especially when we remember that the men were unaccustomed to the work. The material bored through was compact, tenacious and regular, and as yet no indications of "pockets" have been observed. At a distance of 1,600 ft. from the shaft another air lock is being put in; this makes the third lock in the tunnel, the other two being at 800 and 1,200 ft. from the shaft. The new lock is placed in two brick bulkheads, 3 ft. thick, and located one at each end of the lock. It is similar to those already in, being 6 ft. in diameter, 16 ft. in length, and having a door at each end, 3 ft. wide, by 4 ft. high. Up to the present time what we might term the general illumination of the tunnel has been from arc lights located a considerable distance apart. This resulted in the intermediate points being in almost total darkness and, owing to the absence of good reflecting surfaces, all shadows even within a few feet of a lamp were black. Candles are therefore used by the men. An incandescent system is being put in, and it is expected that, with 75 or 100 of these lamps evenly distributed, all the light necessary will be obtained. Freeing the atmosphere from carbon dust arising from the arc lights and candles, and which collects in the nose, is not the least of the advantages anticipated from this plan.

Mr. J. G. ARTINGSTALL, City Engineer of Chicago, submitted on June 3 a report and detailed estimate on the proposed increase of the Chicago water supply. The estimates include the cost of an 8 ft. tunnel extending four miles into the Lake opposite the city and a 10 ft. tunnel from Grosse Point to the city. The ground to be penetrated in both cases is assumed to be dry, hard, blue clay, with a few boulders. The 8 ft. tunnel would cost $158,000 per mile, or $633,600 for the 4 miles. A maximum rate of 12 ft. of tunnel per day is estimated upon, assuming that work can be carried on from both ends. At this rate, allowing 300 working days per year and for delays from stormy weather, it would take 3½ years to build the tunnel. An intermediate shaft 2 miles from shore (costing about $50,000) would shorten the time to 2 years for the tunnel. The 10 ft. tunnel from 12th St. to Grosse Point would be 14 miles in a straight line and 9½ miles of this would be under the Lake. The route on shore would be over 15 miles and the latter will be considered. With shafts every half-mile a tunnel 10 ft. in diameter would cost $218,200 per mile, or for 15 miles, $3,273,600. The average rate of progress would not exceed 8 ft. per day with good ground, or 3 years for completion. The economical capacity of an 8 ft. tunnel 4 miles long would be 80,000,000 galls. per day with a loss of head of 7 ft. The capacity of the 10 ft. tunnel 15 miles long under similar conditions would be 130,000,000 galls. per day with a loss of head of 23 ft.; or with only 80,000,000 galls. used, a loss of 8½ ft. Mr. ARTINGSTALL in his report carefully details the action of the lake currents in carrying sewage and concludes that while there is a great volume of pollution discharged into the Lake, opposite the city mainly, and at intervals from the Chicago river, this pollution never extends far eastward into the lake; but will follow the shore line in a narrow stream for many miles. The pollution at Grosse Point follows the same general law. As pure and wholesome water can be obtained 3 or 4 miles out from the heart of the city as at the same distance from shore at Grosse Point. There is no appreciable difference in the depth of water at either place; the 4-mile line being in water from 6 to 9 ft. deep.

Of recent events in railroad circles, none is exciting more interest than the Vandalia deal by which the Pennsylvania system is threatened with the loss of its line to St. Louis. The Terre Haute & Indianapolis Railroad Company, of which W. R. McKEEN is President, owns a line from Indianapolis to the Illinois State line, and leases the St. Louis, Vandalia & Terre Haute, running thence to St. Louis. Of the stock of the latter company, however, a majority is held by the Pennsylvania Company, which, by a traffic agreement with the leasing company, has supposed itself secure in possession of the St. Louis connection.

The Ives-Staynor syndicate, which has recently been so prominent in railroad deals, has, it seems, been quietly negotiating with President McKEEN and now announces the purchase of the Terre Haute & Indianapolis, including, of course, the Vandalia lease, for the Cincinnati, Hamilton & Dayton Company, which those who read between the lines say means the Baltimore & Ohio interest. Various reasons are given for the action of the parties interested. It is stated that Mr. McKEEN has become dissatisfied with his treatment by the Pennsylvania, especially in their boycott of the commission paying lines, whereby his friendly relations with the Missouri Pacific were broken off and a large amount of traffic thus diverted from the Vandalia.

On the part of the Baltimore & Ohio it is asserted that, aside from a desire to shut the Pennsylvania out of St. Louis as the Baltimore & Ohio has been shut out of New York, the control of the Ohio & Mississippi is becoming none too secure and a St. Louis connection was desired independent of that company. The Pennsylvania Company, however, will not lose its St. Louis connection without a fight. An attempt will be made to break the lease by which the Vandalia is held; and if successful, the construction of 80 miles of new line paralleling the Terre Haute & Indianapolis would give the Pennsylvania again a direct line to the Mississippi, and leave the recent purchasers, owners of an unprofitable piece of property.

The Cincinnati, Indianapolis, St. Louis & Chicago is also affected by the new deal, for they have had a traffic contract with the Vandalia, and have relied on it for an outlet to St. Louis. With their competitor, the Cincinnati, Hamilton & Dayton in control, however, they will have to look elsewhere for a line to the Mississippi. For some time they have been making surveys and obtaining subsidies and right of way for a western extension. This new development will doubtless hurry up matters and it may not be many months before the "Big Four" runs its trains into St. Louis.

LAST week an elevated railway project of vast proportions was developed in Philadelphia. JOHN WANAMAKER, President of the Consolidated Transit Company, presented to Select Council, through the chairman of the railway committee, an ordinance outlining the route of a double-track elevated railway which practically gives two north and south lines through the length of the city, with connecting branches and spurs running towards Germantown and Frankford. The Transit Company offers to pay to the city, on the enactment of this ordinance, $250,000 in cash, at once, and in addition $10,000 per mile as each mile of road is constructed. Among the larger holders of the stock are P. A. B. WIDENER, WM. L. ELKINS and other prominent owners of the present surface Traction Co.; though Mr. WANAMAKER denies any knowledge of the rumored scheme to utilize the elevated project as a means of forcing the owners of the 13th and 15th street surface line to sell to the Traction Co. Vigorous opposition to the elevated project is expected from property owners along many parts of the projected line.

THE Southern Kansas Railroad bridge across Cedar Creek, two miles east of Elgin, Chautauqua Co., was set on fire by an incendiary on June 1, and was burned down. An effort had previously been made to burn the long trestlework west of Elgin, it having been set on fire in a number of places. A farmer who lives near discovered the fire, however and extinguished the flames before serious damage was done. A very similar fire destroyed the International bridge over the Salado, near San Antonio, Texas.

HELENA, Mon., papers say that progress on the Wickes tunnel on the Montana Central R. R. is averaging 6 ft. per day in spite of soft rock and continuous timbering. The tunnel is now driven for 90 ft. from the north portal and indications point to better rock.

THE preliminary tests of automatic couplers by the committee recently organized for that purpose are now in progress in this city with no definite results as yet. The committee consists of W. P. SHINN, A. G. DARWIN, F. M. WILDER, D. H. CHAPMAN, and REUBEN WELLS, all of them men well calculated to act in the matter. As they represent over 30,000 miles of roads which have agreed to abide by their decision, it seems extremely likely that definite results will follow from their work, and certainly none too soon.

THE eight New York members of the Board of Trustees of the Brooklyn Bridge have all been reappointed by Mayor HEWITT, who with the Controller and President of the Board of Alderman, makes the appointments. The Board consists of 20 members in all. The Brooklyn *Eagle* states that Trustee CLARKE was reappointed at his own request on the ground that he was needed as a member of the Committee on New York Terminal Facilities, which we trust means that wiser councils are to prevail in that Committee hereafter. A meeting of the Board of Trustees has been called for an early date. According to the *Eagle* "The Brooklyn trustees have become aware of what they describe as defects in the new plans, and will reopen the matter at the next meeting." It is highly probable.

THE death of Capt. EADS and especially the reported serious trouble on the Panama Canal from the caving-in of portions of the cuts has awakened the Nicaragua canal people to renewed activity. Admiral Ammen is confident that he and his associates can have the project on a working basis "before many months."

IT is generally supposed that transportation lines owned by Government are free from the liability to a change of owners which continually operates with private corporations. This seems not to be the case in Canada, where M. KAMPER, representing a German syndicate, is negotiating with the Dominion Government for the purchase of the Intercolonial Railway, which has over 1000 miles of road on the eastern Provinces. The plans of the syndicate include the establishment of vast iron works in Nova Scotia, title to rich mineral lands near Pictou having been already secured.

THE Surveyor General of Colorado reports that of the 66,880,000 acres of land in that State, 57,787,401 acres have been surveyed. He says further that he has discovered fictitious surveys to the extent of about 1,000,000 acres in certain mountainous sections of the State; a large part of this land is utterly worthless, however, unless possibly for coal and mineral, and it is unsurveyable by the rectangular system.

RAIN storms and floods have done considerable damage in Pennsylvania, Ohio and the Southwest, during the week. On the Southern Pacific line between San Antonio, Tex., and San Francisco, Cal., 27 wooden and iron bridges were swept away; bridges have also been washed away on the Oregon Short Line and the Utah & Northern Railroad. Washouts have accurred on a number of eastern railroads, and several water spouts are reported. Earthquake shocks were experienced at Columbia, S. C., and in California and Nevada on June 3, and at Tucson, Ariz., and the City of Mexico, June 7.

THE most serious railroad accident of the week was a collision on the Louisville & Nashville Railroad, on June 2. Two freight trains collided near Calera, Ala., and were badly wrecked. Three men were killed and one seriously injured. The accident is ascribed to one of the conductors having a defective watch, which misled him as to the time.

OVER the entire Pennsylvania system the old stub switches are being discarded and the split-switch substituted. The company west of Pittsburg is doing a great deal this season in the way of putting in new switches, and new frogs of improved pattern.

A VERY thin rumor comes from Paris to the effect that an enterprising contractor had brought to that city nine negro chiefs from the African coast, with the intention of showing them the sights of the French capital and then inducing them to contract to send laborers from their tribes to work on the Panama canal. Jamaica negroes must be growing scarce; or perhaps wiser.

Traction Rope Railways.*

BY D. J. MILLER, MEMBER OF THE WESTERN SOCIETY OF ENGINEERS.

[Read March 1, 1887.]

(*Concluded from page 360*)

MOTIVE POWER.

The building containing the motive power of the Tenth avenue cable road is situated on the east side of Tenth avenue, having a frontage of one block (200 ft.) The plant consists of two 28 by 48 Wright engines, arranged to be operated together or independently, as may be required. One continuous line of main shafting is used, transmitting power to four driving drums, each pair being connected by a system of gears, and power transmitted from the main shaft by friction clutches, which are composed of sixteen wrought-iron and steel plates, each three-eighths inch thick by 4 ft. in diameter. These plates give sufficient area in square inches, so that the pressure applied to operate one rope will not force the lubricant from between their surfaces. The driving drums are 10¼ in. face, with five grooves each, which are about 12 ft. in diameter, the first groove on the first drum being the largest; the first groove on the second drum is one-eight inch less in circumference than the first groove on the first drum, and all other grooves are reduced successively in the same ratio. Each pair of driving drums has an independent train of driving gears, and in the center, between the drums, a pair of 8 by 8 upright engines are located. These are connected together and so arranged that they can be thrown in gear to operate the main drums.

To avoid accidents and stoppage of the road from stranding of the rope it is necessary to frequently examine the cable to keep it in perfect order. To do this thoroughly, the rope should be detached from the main machinery and operated at a slow rate of speed. The service required of the auxiliary engines is to move the rope slowly for examination, run an old rope out and a new one in, or for any repairs necessary on the main machinery. The driving machinery being divided into 2 sets of 4 driving drums each, and each set having the drums arranged in pairs, the auxiliary engines between same can be connected to operate either pair as may be desired. The cables are taken in around said drums and make 2 or 3 wraps, then pass to the tension wheel, which is on a car, and traverses a track in the rear of the driving machinery, then are carried out into the street again. With cables about 4 miles in length, they give a movement to the tension car of from 4 to 5 ft., making from 8 to 10 ft. of rope to be disposed of every few minutes, thus continually moving the tension-car back and forth.

As the car with the wheel is quite heavy, its movement is not easily checked, and a quantity of rope is usually payed out and received into the building, which would not be the case if car were properly governed. This duplicate system has been provided with an automatic variable tension, decreasing or increasing the tensile strain on the traction rope as the circumstances may require.

CABLES.

Each cable for the Tenth avenue road was manufactured complete in one piece and shipped to 128th street and Tenth avenue, mounted on a single reel, which with cable weighed 94,000 lbs.

Cables used on the majority of roads are composed of six strands, each strand having nineteen wires, seven of them forming the heart, around which the remaining twelve are wrapped; and these latter receive all the wear. One of the Tenth avenue cables has seven small and nine large outer wires, while the second rope is composed of nine small inner wires with ten larger outside wires. This change in the size of wires was made by the rope manufacturers as an experiment.

For every mile of single track there are over 150 carrying pulleys, and on a road running ten miles per hour for 24 hours the cable will pass over 36,000 carrying pulleys each day; there are also horizontal wheels on curves, and several large sheaves in wheel vaults, and should any number of the above be out of order the cable must be seriously injured.

ESTIMATED COST OF CABLE ROADS.

Many inquiries have been made concerning the cost of a good cable road, and the operating expenses of the same. We give below some information on this subject, and although the different items are not detailed, the figures are sufficiently accurate for the purpose. The estimate is for 2½ miles, everything included:—

2½ miles road-bed complete, paving included..	$319,000
Plant, including real estate, buildings and motive power complete.....	113,500
Rolling stock.....	70,000
	$502,500
Add 10 per cent. for miscellaneous expenses,...	50,250
Giving total cost of road and equipment.....	$552,750
Operating expenses per year, $102,953. To this add interest at 5 per cent. on first cost of road, say $600,000, $30,000, making total operating expenses.....	132,953

This would require a traffic of 2,659,060 per annum. The excursion traffic being a large item with all cable roads, we will therefore allow 25 days during the year in which 20,000 passengers will be carried, making 500,000, leaving 2,159,060 passengers to be carried in the remaining 340 days, which gives us 6,350 passengers per diem.

If 75 per cent. of this number, or 2,000 per mile per day, can be calculated on with a horse road, it will be perfectly safe to invest in the cable system owing to the increase.

As the above is for 2½ miles, one mile of road will cost $221,100. By multiplying the latter figure by the number of miles desired to build, a close and reliable estimate will be obtained. The foregoing covers real estate, buildings and equipment. Operating expense covers officers' salaries, pay of employés, taxes, and in fact every item of expense connected with the operation of the road.

It must be borne in mind that the estimate given above covers the expense of making 435 round trips every 24 hours.

To perform this work with animal traction would require 272 horses on a comparatively level road, which would cost annually for maintenance and renewals.....	$59,568
The operating expenses of the motive power with the cable system...	26,640
Showing saving annually effected....	$32,928

The estimate on cost, and also operating expenses, are liberal, but the minimum number of horses have been considered. With animal traction, there could be no sudden expansion of the carrying capacity; but with a road such as described above it is only necessary for a railroad company to have adequate rolling stock and they are prepared for any emergency. There is no other system of traction that can so readily respond to the demand of traffic for increased accommodation.

Two passenger cars can be attached to a single grip-car and carry, easily, 125 passengers. And by supplying cars sufficient to despatch one train every minute a carrying capacity of 7,500 per hour in one direction would be secured, or a total of 15,000 passengers.

The estimate of cost here given is based on prices and conditions for construction of roads in large cities such as New York, Philadelphia, Boston and Chicago. For smaller cities considerable reduction might be made.

As this paper is now quite lengthy, we deem it advisable to bring it to a close, omitting several subjects upon which we had intended to treat; and trusting we may be able to furnish a supplement in the near future. We give in conclusion a list of the cable roads now in operation and under construction.

LIST OF CABLE ROADS IN OPERATION AND UNDER CONSTRUCTION IN THE VARIOUS CITIES IN THE UNITED STATES.

Chicago.

Chicago City Railway Company: Cottage Grove Avenue, and State Street Lines, 20¼ miles, in operation since 1882; State Street and 63rd Street Line, 4 miles, under construction; Cottage Grove Avenue Extension, 4 miles, under construction.

North Chicago City Ry. Co.: 14 miles, under construction.

Cincinnati.

Mt. Adams & Eden Park Inclined R. R. Co.: Walnut Hills & Cincinnati Line, 8 miles, in operation since Oct. 1, 1886.

Kansas City.

Kansas City Cable Ry. Co.: 4 miles, in operation since June, 1885.

Metropolitan Ry. Co.: 14 miles, under construction.

Corrigan Consolidated Ry. Co.: 16 miles, under construction.

New York City.

Third Avenue R. R. Co.: duplicate system; Tenth Avenue Line, 6 miles, in operation since August, 1885; 125th Street Line, 4½ miles, in operation since Dec. 1, 1886.

Philadelphia.

Philadelphia Traction Co.: Market Street Line, 8 miles, in operation since the spring of 1885; Sansom Street Division, 4 miles, in operation since October, 1886; Columbia Avenue Division, 5 miles, in operation since the beginning of 1885.

St. Louis.

St. Louis Cable & Western Ry. Co.: 6 miles, in operation since April, 1886.

San Francisco.

California Street Cable R. R. Co.: 5¼ miles, in operation since 1876.

Clay Street Hill R. R. Co.: 2 miles, in operation since August, 1873.

Geary Street Park & Ocean R. R. Co.: 5 miles, in operation since 1880.

Market Street R. R. Co.: Market street and branches 16½ miles, in operation since 1884.

Omnibus R. R. & Cable Co.

Sutter Street R. R. Co.: 3¼ miles, in operation since 1876.

Telegraph Hill Street Ry. Co.: 3,120 ft.

Several miles of road have recently been put in operation in Melbourne, Victoria, and about four years ago a road was built in New Zealand. In 1884, 2 or 3 miles were constructed in London, England.

Discussion by Mr. Augustine W. Wright.

I have listened with interest to the paper just read, describing Mr. MILLER's Duplicate Cable System, and will attempt to follow the same in what I may say.

In "WOOD's Treatise on Railways," there will be found the following: "In the year 1788, Mr. REYNOLD's completed, at the Ketley Iron-Works, an inclined plane, formed of a double iron railroad, by which a loaded boat in passing down a frame, constructed for the purpose, drew up the boats which were empty. Since that time many inclined planes have been made upon railroads for the purpose of drawing up the empty carriages by the gravitating power of the loaded carriages down the plane." * * * "In 1808, Mr. COOKE erected an engine upon Bertley Fell, in the County of Durham, to draw the loaded carriages up the Cappets Colliery, across the Durham and Newcastle turnpike road, in a steep ascent; and since that time they have been much used upon the railroads in the neighborhood of Newcastle."

The members present are doubtless all aware that when the Liverpool and Manchester Railway was about completed the question of motive power had to be considered. It was the original intention to operate that road by horse-power, but the cost of construction proved so great that it became evident that all the toll earned by horse transportation would not suffice for maintenance and interest on the investment. The Board of Directors thereupon decided to refer the question, "What under all circumstances is the best description of moving power to be employed upon Liverpool & Manchester Railway" to a committee consisting of, RASTRICK, WALKER and (ROBERT) STEPHENSON, three of the most eminent engineers in England. RASTRICK and WALKER reported in favor of stationary engines, STEPHENSON in favor of locomotives. I have that report in my library, and it is very interesting at this day. The plan proposed was to have a train moving toward the power station draw a tail rope. The next train in the opposite direction would be drawn by the tail rope of the first train and draw behind it a rope to be used by the next train in the opposite direction, etc.

The cable system of to-day originated with the construction of the Clay Street Hill Cable Railway in 1873, by A. S. HALLIDIE and a few friends, in San Francisco. The grades of Clay street were so steep that property was not worth much, but the chances of success in the proposed cable road were considered so slight that property owners preferred to donate money, not deeming the stock of any value. The road was an immediate success, and the system was introduced upon other roads in San Francisco. The steep grades, 17 ft. in 100, of San Francisco were very favorable for cable operation, as compared with horse-power.

I agree most heartily with all Mr. MILLER says of our fellow member Mr. CHARLES B. HOLMES, of Chicago. It required no ordinary amount of pluck and determination for Mr. HOLMES to peril his business reputation and advise his company to risk millions in the construction of a cable road in Chicago, when the variations of temperature, the climatic and traffic conditions were so great. I, forone, must admit that the venture did not meet with my approval. I did not believe it possible to use a cable 25,000 ft. long and in addition to moving all the cars with their loads propel another cable passing around five curves of about 50 ft. radius and angles of 90 degrees. It is estimated that twenty-eight horse-

*From Journal of the Association of Engineering Societies; May, 1887.

power is required for each curve, but this rope does the business. As to the amount of *débris* that drops into he conduit through the slot opening in the street, this will vary not only with every city, but with each block of any street. If the adjoining streets are unpaved each vehicle will carry a greater or less amount of mud on to the paved street, where it drops off. I am informed that the average depth of mud dropping into the Chicago City Railway conduit does not exceed one and a half or two and a half inches deposit in winter months.

Cutting the Carrying Sheaves.—Ordinarily there are provided 165 carrying sheaves per mile of single track cable railway. The tendency was to make these carrying sheaves of the largest possible diameter, thus lessening the amount of power requisite to propel them. With the same size journal, it is evident that the amount of power required to turn the sheave will vary inversely as its radius. For instance, suppose that your journal is 1-in. in diameter. If the carrying sheave be 12-ins. in diameter, and it required two pounds pull to turn it, should you substitute a carrying sheave of 24-ins. diameter, one pound would suffice; but this leverage works both ways. Suppose you get one pound of ice or frozen mud on the rim of your carrying sheave. If one pound pull sufficed, ordinarily applied to the circumference, to revolve the sheave, it is obvious that it will not revolve against the leverage of one pound of ice, and the cable would in a short time cut into and ruin the sheave. The carrying sheaves upon the Chicago City Railway were first made 16-ins. in diameter, but the ice, etc., stopped their turning, and sheaves of 12-ins. diameter, have been substituted. The resonant ringing sound of which Mr. MILLER speaks is attributed frequently to the method of carrying or supporting the sheave. If it is supported by wire lugs on the wire yoke the vibration is thought to be increased. To lessen this noise Messrs. KNIGHT & BONTECOU, engineers of the Grand Avenue Cable road in Kansas City, support the carrying sheaves on brick piers.

Regarding the construction, I should differ from Mr. MILLER. To my mind, each cable road should *not* be built and planned entirely to withstand the street traffic. Where great variation in temperature exists, any structure strong enough to withstand the contraction and expansion of the paving or material composing the street surface will have abundant strength to carry any ordinary street traffic. The various roads have cost from $30,000 to $105,000 per mile of single track for street work.

Regarding the Duplicate Cable System, I would say that it is, in my opinion, simple increasing the first cost as a matter of insurance against detention, and I question whether it is worth the cost. This system is in use upon the Tenth avenue road of New York City and was put in upon the Kansas City Cable road, but afterward abandoned. The reasons given were as follows:

"1st. It took more time to change from one cable to the other than was required to repair a damaged cable.

"2d. The idle cable got cut and chafed by the running cable to such an extent as to render it useless when most required.

"3d. The idle cable by lying in the tunnel got covered with grit and dirt, which is very injurious to it. This objection could be overcome by moving the idle cable slowly with special engines erected for that purpose.

"4th. It involved increased expenditure of capital and labor for which there was no adequate return."

Carrying Sheaves.—Regarding this question, Mr. HENRY ROOT, engineer of the Market street road in San Francisco, informed me that ordinary carrying sheaves had been running since 1878 in that city. The carrying sheave should be accurately balanced and trued up on emery wheels.

REPLY TO MR. WRIGHT—BY MR. MILLER.

Engineer WRIGHT very honestly admits that the construction of the cable roads in Chicago did not meet with his approval, which is putting it very mild, to say the least.

Mr. WRIGHT remarks "that it is estimated that 28 horse-power is required for each curve," presumably referring to the curves on the Chicago road. We take it for granted that he means the power required to move the cable, cars and passengers. For the four curves on the State street road, with nine miles of single track, it required about 115 horse-power to move cables, carrying and guiding pulleys, independent of driving machinery or cars.

Mr. WRIGHT says, "ordinarily there are provided 165 carrying sheaves per mile of single track," and we presume that he has reference to wheels as spaced in Chicago, namely, at intervals of 32 ft. In New York we place them at intervals of 35 ft.

We judge that the information given by Mr. WRIGHT in regard to hanging the pulleys is second hand, and that he does not speak from personal knowledge on this subject. In our experience we have found that a wheel attached to the truss of the road-bed, or resting on supports independent of the iron structure, or connected to the iron structure of the track with a block of wood inserted to break the metallic connection between the cable, track-rails and slot-rails, really has no effect on the resonance of the carrying pulleys. The ringing sound will be more or less controlled by circumstances; for instance, by the cable being filled with tar or running empty, new or worn cable, and also design of carrying pulley. A new rope with no tar will make considerable noise, whereas a worn cable well filled with tar will make comparatively none. The only way that the noise can be prevented is, as we stated, by filling the carrying pulley with some non-metallic substance. However, the ringing is not sufficient to make any material difference in a street with much traffic.

As regards Mr. WRIGHT'S knowledge of the duplicate system, we find from his own remarks that this is extremely limited, and the four objections which he has taken from the *Street Railway Journal* are mere assertions made by a party in Kansas City, and these were fully answered about a year ago.

It must be remembered that the inventor of the duplicate cable system was never in Kansas City until the cable road there had been in operation some six months, and we think Mr. WRIGHT somewhat unjust in quoting but one side of the controversy. If duplicate cable are a failure, then the whole cable system is a failure, for the simple reason that with single rope roads two cables are often operated in the same conduit, and under the same conditions as the duplicate cables are operated in the duplicate system, and we are pleased to inform Mr. WRIGHT that the duplicate cables have been in successful operation on a section of the Chicago roads for four years.

The saving in the pay-roll with the duplicate system will more than pay the interest on the investment for the second rope, to say nothing of the great advantages of keeping the road in constant operation without use of horses.

Our paper was not intended to describe the duplicate system particularly, but we consider the notice justified by the unquestioned success of the Tenth Avenue Cable road.

Owing to the first cost, it is only practicable to adopt the cable system on lines carrying from 2,000 to 3,000 passengers per mile per day. The small additional cost for the second cable is but a "drop in the bucket" where so large an outlay is to be made, and when the objections to the single rope are considered, chief among which is the frequent stoppage and consequent detention of traffic, we fail to see the economy of doing without the second rope. Were cheapness the principal desideratum we would not construct a cable road.

It is not the investment alone, but the percentage to be realized on the investment, that is the question to be considered.

The New Method of Dimensioning.

BY ALFRED D. OTTEWELL, C. E.

III.

In article II was given the method by which formula (*A*) was derived. That derived formula is the equation of a straight line, so that if the inferences from which formula (*A*) was deduced are correct, we see that from the nature of things the values of the safe working strength of a material such as wrought-iron or steel, under varying conditions of loading, can be represented graphically by a straight line only. The numerous attempts to represent the results of the experiments of WÖHLER and SPANGENBURG by curves of more or less complexity would therefore appear to be from the nature of things very much like the numerous attempts to solve the problem of perpetual motion.

It was found in Article I that in almost the worst case formula (*A*) only requires an increase in weight of 27.4 per cent. over standard specification. This, however, is in excess of the truth, for if 27.4 per cent. was added to the dead load of the bridge, the allowable unit stress would be increased about 10 per cent., and the weight of the bridge be reduced for this reason about 10 per cent., so that formula (*A*) in the worst case only requires an increase of weight of say 20 per cent. over standard specifications, or an increase in cost of 6 or 7 per cent., whilst it is probably 50 to 60 per cent. stronger.

The superior practical value of the proposed formula (*A*) over that adopted by Mr. WILSON is confirmed by the fact that the latter fails in one of the critical limits; for in the specification for bridges for the Pennsylvania Railroad Co., Mr. WILSON finds it necessary to say that "Floor beam hangers must have an additional section of 25 per cent. above that given by the before mentioned limiting stresses;" and other specifications embodying Mr. WILSON'S formula have to make a similar exception. Formula (*A*) will give a value varying little from 6,000 lbs. in any case, a value which approximates to the special value given by the above specifications and practically agrees with the 6,000 lbs. adopted by Mr. THEODORE COOPER for iron railroad bridges.

The objection has been raised to this method of dimensioning that no distinction is made for the variable quality and form of the different members. For instance, it is asserted that (1), the same working stress should not be allowed on a large tension member as on a rod of small diameter, and that (2), the same working stress should not be allowed on a short suspension link as on a long tie rod; and that because such variations are not taken into account by LAUNHARDT'S formula, the general application of this method of dimensioning to all varieties of bridge members is premature. The first objection given applies as much, or as little, to the old method of dimensioning as it does to the new, for the variable quality of material in the different sized members is fully considered in our best bridge specifications under "Quality of Material," and in neither method does the allowable working stress depend upon the sectional area of the member. The second suggested objection appears to be more imaginary than real. Why will a bar of a sectional area of 8 sq. in. break under a less unit stress than a bar of the same material of a sectional area of 4 sq. in.? Because the former has not been rolled so much as the latter and has consequently fewer fibres to the square inch and is not so homogeneous. When a long tie, however, is compared with a short one of the same sectional area, the number of fibres to the square inch may be assumed to be the same in both cases, and hence from this cause alone the strength of the one would not differ materially from the strength of the other, but a long tie cannot be expected to be as homogeneous as a short one, and hence it might be supposed that a long suspender would bear a *less* working stress than a short one*, and it would, were it not counterbalanced by the fact that a long tie yields and stretches less per lineal foot than a short one, and is thus fatigued less. The right to strain counter rods and long verticals to 8,000 or 9,000 lbs. per sq. in. is, therefore, very questionable, when we strain floor-beam hangers to 6,000 or 7,000 lbs. per sq. in.

The new method of dimensioning involves the greatest change from the old method in the lightest bridges, and in the lightest members of the same bridge, the change in these cases being from a lighter to a heavier section. The new method therefore is in accordance with experience, for every engineer knows that he has seen the time when he has not dared to make certain members as light as his calculation called for; his experience in such cases being more reliable than his theory. For the same, or corresponding members in larger bridges, however (as for instance the posts and ties, at middle of truss), the writer's argument is, the engineer's experience has failed him, and a few weak links have been inserted in an otherwise strong chain.

The adoption of the new method of dimensioning does not necessitate unpractical attention to the small details of a structure. For example, the writer does not consider it necessary, in practice, to vary the allowable shearing, bearing and bending stresses for bolts, pins and rivets, for different values of $\frac{min.\ B}{max.\ B}$. The values given in standard specifications for these stresses are derived from experience, not theory; experience being in this case, as in cases already mentioned, more reliable than theory. Where joints have failed because of weak bolts, pins or rivets, the allowable unit stress on these bolts, pins and rivets has been decreased, for spans of all sizes, until safe unit stresses have been reached. Such failures have been most frequent where the live load has been most severe, and hence these safe unit stresses derived from experience happen to correspond closely with the lowest values for unit stresses

*WEYRAUCH (Strength and Determination of the Dimensions of Structures of Iron and Steel, p. 33, J. Wiley & Sons,) argues from the experiments of KIRKALDY, VICKERS and others, that "in general a very short rod should carry a greater DEAD load than a longer one of the same material and cross section." The word "dead," which the writer of this article has emphasized, is very significant Should it be a live load, fatigue would modify the result.

based upon formula (A). It is as unnecessary, therefore, as it is unpractical to change these values with every change of $\frac{min.\ B}{max.\ B}$. Thus, the following specification conforms with the lowest values given by formula (A), and will give results differing little from those produced by standard specifications:

The allowable stresses on bolts, pins and rivets in pounds per square inch shall be as follows:

	Wrought-iron.	Steel.
Shearing on bolts, pins and rivets	6,000	7,500.
Bearing, on projected semi-intrados of bolt, pin and rivet holes	12,000	15,000
Bending, stress in extreme fibres of pins	12,000	15,000

For rivets driven in the field the above limits of shearing strain and pressure shall be reduced one-third part.

In the longest spans it may prove economical to obtain from formula (A) the special unit stresses for truss pins.

For bridges of different spans the writer would prefer the following kinds of girders:

Spans up to 16 ft. ..... Rolled beams.
" 16 to 80 " ..... Riveted plate girders.
" over 80 " ..... Pin connected trusses.

According to this specification the permissible unit stress in the flanges of beams and girders obtained by formula (A) would not vary between its limiting values as much as 1,000 lbs., and hence in this case also it is considered an unnecessary refinement to vary the unit stress for different values of $\frac{min.\ B}{max.\ B}$. In the bottom flanges of beams and girders the writer would therefore propose that the allowed stress in pounds per square inch shall not exceed:

	Wrought-iron.	Steel.
For riveted girders (stringers)	5,500	7,500
For riveted girders (except stringers,) and rolled beams	6,000	8,500

and that in the compressed flanges of beams and girders subject to transverse stress the allowed stress in pounds per square inch shall not exceed:

	Wrought-iron.	In no case to exceed.	Steel.	In no case to exceed.
For riveted girders (stringers)	$6{,}200\left(1-\frac{l}{120\,w}\right)$	5,500	$8{,}400\left(1-\frac{l}{120\,w}\right)$	7,500
For riveted girders (except stringers,) and rolled beams	$6{,}800\left(1-\frac{l}{120\,w}\right)$	6,000	$9{,}600\left(1-\frac{l}{120\,w}\right)$	8,500

Where l = unsupported length in inches.
w = width in inches.

Diagram III shows graphically that between practical limits the above formulæ are as correct as the

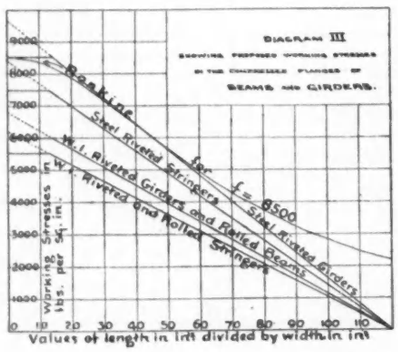


DIAGRAM III
SHOWING PROPOSED WORKING STRESSES IN THE COMPRESSED FLANGES OF BEAMS AND GIRDERS.
RANKINE
Steel Riveted Stringers
W. I. Riveted Girders and Rolled Beams
W. I. Riveted and Rolled Stringers
Steel Riveted Girders
f = 8500
Working Stresses in lbs. per Sq. in.
Values of length in ins divided by width in ins

following formula of RANKINE, generally used for the compressed flanges of beams and girders:

$$c = \frac{f}{1 + \frac{l^2}{5{,}000\,w^2}}.$$

Where f = permissible stress in pounds per square inch when in pure compression.
c = allowable working stress in pounds per square inch.
l = unsupported length in inches.
w = width in inches.

The curved line corresponds with RANKINE'S formula for the particular case of $f = 8{,}500$, the horizontal and inclined lines shown in full, correspond with the above proposed formulæ and are proposed because of their simpler and more practical form. The inclined lines are tangent to RANKINE'S curves at the points of contra-flexure, thus deviating as little as possible from those curves.

On account of the infrequency of the maximum strains in lateral bracing it is also considered unnecessary to vary the unit stresses for different values of $\frac{min.\ B}{max.\ B}$. For this reason the allowed stresses on lateral members, in pounds per square inch, are proposed as follows:

	Wrought-iron.	Steel.
Rods in tension	15,000	21,000
Plates or shapes in tension.	13,500	18,000
Plates or shapes in compression. (Lateral struts).	$13{,}500\left(1-\frac{l}{220\,r}\right)$	$18{,}000\left(1-\frac{l}{220\,r}\right)$

Where as before:
l = length of piece in inches, center to center of connection.
r = least radius of gyration of the section in inches.

The above modifications to standard specifications are for railroad bridges. For highway bridges the writer would propose the following specifications:

The allowed stresses on bolts, pins and rivets, in pounds, per square inch, shall be as follows:

	Wrought-iron.	Steel.
Shearing, on bolts, pins and rivets	8,000	10,000
Bearing, on projected semi-intrados of bolt, pin and rivet holes	16,000	20,000
Bending, stress in extreme fibres of pins	16,000	20,000

For rivets driven in the field the above limits of shearing strain and pressure shall be reduced one-fourth part.

In the bottom flanges of beams and girders the allowed stress in pounds per square inch shall not exceed:

	Wrought-iron.	Steel.
For rolled beams and riveted girders, net section	9,000	13,000

The top, or compression flanges of beams and girders, shall be made of the same gross section as the bottom or tension flanges.

The allowed stresses in lateral members shall be the same as given above for railroad bridges.

In article I the formulæ of Messrs. CAIN and WILSON were adopted for iron highway bridges. For steel highway bridges the same formulæ would be adopted, in which, for steel to the specification given, $u = 10{,}500$ lbs. for links and rods in tension, and 9,000 lbs. for plates or shapes in tension or compression.

It is believed that the most important clauses, found in standard general specifications for highway and railway bridges and viaducts of iron and steel, that are directly affected by this new method of dimensioning, have been considered in these articles and the necessary modifications given.

In the belief that the new method of dimensioning will become before long *the* method of dimensioning, that the formulæ herein proposed are of practical value, being based upon experience and experiment, and that there is a need for such formulæ, the writer submits these articles for the consideration of members of the profession, who

"On reason build resolve—
That column of true majesty in man!"

To Test the Hardness of Water.

H. J. HARDY, F. C. S., in the *English Mechanic*, thus describes the test for determining the total hardness of water:—

Take 50 c. cm. of the water, place in a stoppered bottle of about 10 ounces capacity, and run in standard soap solution until, after well shaking, allowing the bottle to lie at rest on its side for four or five minutes, the lather does not break up—or, in other words, until a permanent lather is obtained. Sometimes a false permanent lather appears, but by always adding another cubic centimeter of soap solution, when the process is thought to be finished, this error may be obviated, as the lather will at once commence to break up if it is not permanent. Should the water be a magnesia water, the entire solution must be so regulated that only about 8 c. cm. of the soap solution is used. If 50 c. cm. of the sample takes more than 10 c. cm. soap solution, dilute 50 c. cm. of the sample with 50 c. cm. of distilled water and work in half, doubling of course the number of cubic centimeters of soap solution used. For every 50 c. cm. of water used, whether sample or distilled water (for dilution) 1 c. cm. must be deducted for absorption. Magnesia may be estimated by precipitating the lime and applying the soap test to filtrate. Multiply result by $\frac{40}{72.5}$ and it will give grains of magnesia per gallon. The permanent hardness may be estimated by taking about 0.5 liter, placing in a flask connected with an inverted condenser, and boiling for an hour. The water is then filtered from deposit, 50 c. cm. of the filtrate taken, and the soap test applied as before. This gives permanent hardness. This total hardness less the permanent hardness gives temporary hardness.

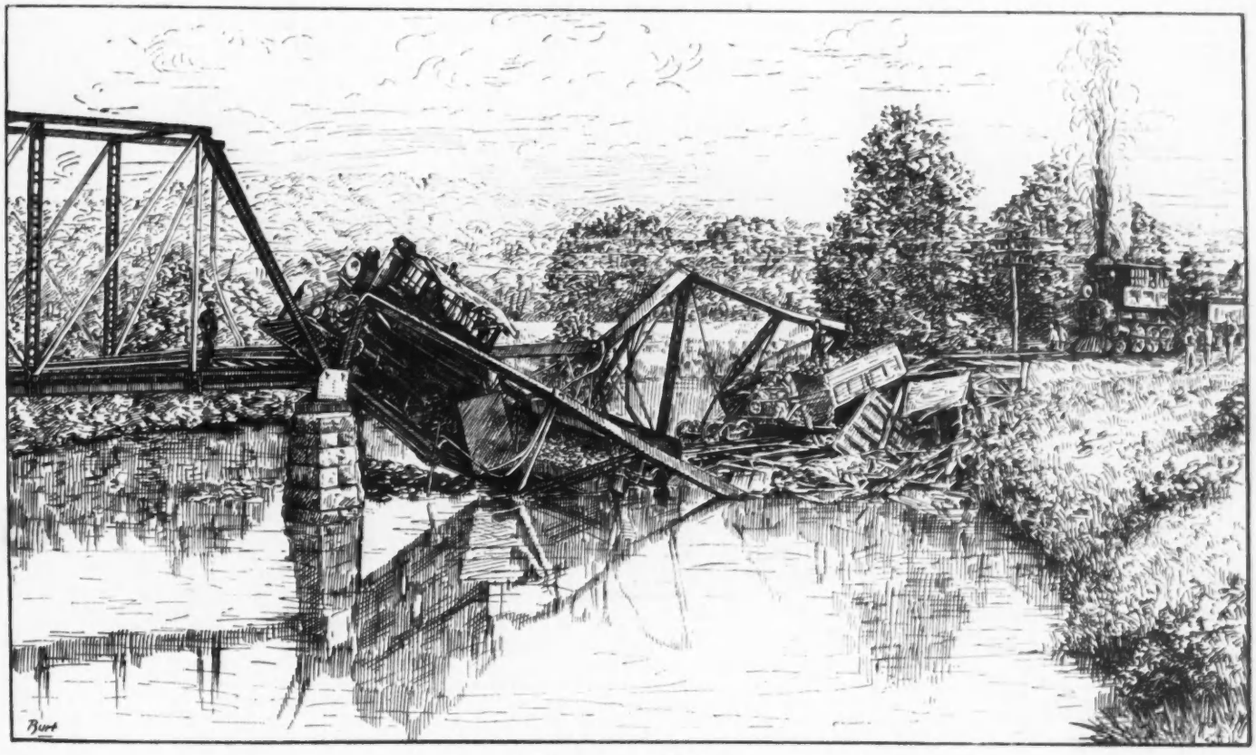
The following is the method for preparing the standard soap solution, which, on the authority of Tichborne, requires no setting against a known quantity of calcium carbonate. Take 5 c. cm. of as pure as possible oleic acid, add about 50 c. cm. of proof spirit and two drops of phenolphthalein. Run in a normal solution of caustic soda until the color is just struck. Since it is found that 15.5 c. cm. require the solution to be made up to 820 c. cm. with proof spirit, therefore n being the number of cubic centimeters of soda used $\frac{n \times 820}{15.5}$ = number of cubic centimeters it is to be made up to. Working on 50 c. cm. of the sample, each cubic centimeter of this soap solution equals 1 grain of calcium carbonate per gallon, Another method, and one which I have found to give very good results, is as follows: Temporary hardness: Take 70 c. cm. of the sample; make hot in a porcelain dish; add a few drops of phenoacetoline and titrate with fiftieth normal sulphuric acid. Each cubic centimeter of the latter used equals grains per gallon of temporary hardness. Permanent hardness: Take 70 c. cm. of the sample; add about as many cubic centimeters of fiftieth normal sodium carbonate solution as there are grains per gallon of solids (non-volatile); transfer to a platinum dish, and evaporate to dryness over a water-bath. Take up with recently boiled distilled water, which must be perfectly cold, filter, wash residue well, and make filtrate up to about 70 c. cm. Make this solution hot, add a few drops of phenoacetoline, and titrate with fiftieth normal sulphuric acid. The number of cubic centimeters used, deducted from the number of cubic centimeters of fiftieth solution sulphuric acid previously added, equals grains per gallon of permanent hardness. There is no hard and fast rule as to how much lime must be added to soften water; all depends upon the nature of the water. Permanently hard waters cannot be softened by the mere addition of lime, as this only removes bicarbonates and does not affect sulphates of lime and magnesia.

SEVERAL of our own economical railway corporations doubtless have good reason to appreciate the remarks of *The Engineer*, quoted below, and others probably will have, unless they conclude that an engineer is a very essential official on their road: "It is not generally known that the Great Western Railway Company is wriggling along without a chief permanent way and works engineer. The directors hear the notions of various people and sit in judgment on many important questions, and, after striking a sort of average, vote that work shall be carried out this or that way, that sleepers are or are not required, that they should be turned upside down, or that structures are safe or unsafe, no doubt generally safe. It may be hoped that nothing in the way of a big smash will occur, because it would be rather hard on the directors if they were convicted of negligence and culpable inefficiency for the work they took in hand."

Cincinnati, O.—H. J. STANLEY, Chief Engineer, Board of Public Affairs, has submitted his report for 1886, being the thirtieth annual report of the Civil Engineer's Department. During the year 2.56 miles of new sewers were built; the system comprises 74.735 miles, of which 47.566 miles are pipe and 27.169 miles brick and stone; there are about 5.344 ft. of egg shaped sewers from 24 by 32 ins. to 42 by 54 ins. There are 470 miles of avenues, streets and alleys; 256 miles being improved and 214 miles unimproved. The report contains complete tables of improvement work, showing the class of work, location, contractor, cost, sizes of sewers, etc., and is accompanied by a map showing the sewerage system.

The Consequences of a Cow.

We regret that the wicked cow which brought the *very* careful calculations of some able engineer to naught in the bridge of which we give a picture herewith, is not visible in the engraving as collateral evidence to the fact that it was a cow alone which brought it down, and no defect of the structure, which was "amply strong for all legitimate requirements." The peculiar locomotives will show



The Consequences of a Cow.

that the "accident" occurred on the Baltimore & Ohio Railroad. Its scene was Independence, O., and the time about a month since, on April 30.

Whether the cow was actually hit by the locomotive and so flung against one of the posts, as the officers of the road alleged, or whether the cow happened to swing its tail against one of the compression members just as it was taking strain from the locomotive, we cannot say, but the internal evidence rather favors the latter theory, for the span was so short that had the break occurred directly *under* the locomotive that machine would have been likely to have escaped before it fell, as at the Bussey bridge, and the cars only have been dropped into the stream beneath. At any rate, it was certainly the cow which did the mischief, for it will be seen that the locomotive did not leave the rail. The bridge itself was strong enough, as it had carried locomotives safely for several years, and its strain-sheet shows that the moments of every wheel were very accurately computed, and the precise sections required determined therefrom according to Wöhler's laws. The moment of the cow was the only thing left out of the calculation, and it had no business on the bridge. Moreover, we are not so sure, on second thoughts, but that the cow was a horse.

The way in which the whole structure fell to pieces like a pack of cards under the effect of this slight additional impact, whatever it was, tells a story which it is needless to enlarge upon. The span was very small, the structure very high, and the last ounce of material had been saved in it. The day is near at hand, let us hope, when it will ruin a man's professional reputation to have either designed or accepted such a bridge. It cannot come too soon, but the surest and quickest way to bring it about, as respects this particular kind of atrocity, is to forbid by law the erection of pin-connected bridges of such short spans, and to require that, all bridges below a certain considerable span shall be heavy enough to carry a buckle-plate floor and coating of ballast, and be provided with it, so that the dead load shall bear some reasonable and rational relation to the live.

It will be observed that the floor held together pretty well, and its spring was enough to buckle the tension member of the first panel of the otherwise uninjured succeeding truss. This member, however, can be straightened, and no doubt has been, leaving the second truss to await the convenience of some other cow;—unless a freshet carries away the structure sooner, as would seem probable from the height of the structure above low water.

Country Roads.

JOSEPH S. PERRY, at a recent meeting of farmers in Boston, gave them some seasonable advice on road-making. After noting the common practice which he characterized as an outrage on civilization he pointed out the fact that nearly every New England farmer had upon his land a material that could be utilized in making good and lasting roads. These were the stones of all sizes that were now a nuisance on the farm and were disposed of in the corners of the fields, on the roadside, in ravines and everywhere except where they would do some good—and that is in the middle of the road.

Mr. PERRY then shows how he would make his road as follows:—When the width of the road is decided upon either 8 ft. with very ordinary travel or 16 ft. for more travelled highways, take a strong plow and commencing on the outside of the road turn the furrow outward and go a certain distance which may not incommode the public. Then turn around and take the other side, also turn the furrow outward and plow over in the same way two or three times. If depth enough is not secured in this way secure it with a scoop shovel. The stone should then be packed in the roadway to the depth of 18 in., placing the large stones on the bottom; crown it so that there will be nearly one inch of fall to the foot from the center outward, and take special care in compacting and laying the top layer of smaller stone. Once in 8 or 10 rods put in a sluice-way and finally cover with from one to two inches of gravel well raked and rolled in. When this is done Mr. PERRY assured his hearers they would have a road that with a very little care would last for generations and be a good road at all seasons of the year.

A New Executive Department of Public Works.

BY GEN. W. F. SMITH, in *The Forum*.

At the formation of the Federal Government under the Constitution it was natural that the administrative bureaus should be few in number and simple in character. With the increase in the wealth and population of the country new varieties of duties have arisen, calling for the formation of new bureaus. The extraordinary development of the nation under a century of constitutional rule has necessitated, for the performance of administrative duties, the gradual erection of a vast and cumbrous machine; and as it has arisen by additions to the original simple apparatus which served the early administrations, it would be a matter of wonder if, after a century of experience, great improvements could not be introduced. Simplicity in machinery means economy and an increase in effective work. To apply this principle to the governmental machine would seem eminently proper, now that the annual expenses of running it are so large as to vie in amount with the cost of maintenance of the greatest monarchical governments. Among the duties of our Federal Government there is a class necessitating large annual expenses of administration, which may be called the Civil Public Works. These are:

1st. *The Improvement of Rivers and Harbors*, which, by precedent only, is in the hands of the Secretary of War, and carried on by the Engineer Corps of the Army.

2d. *The Coast and Geodetic Survey*, under a bureau attached to the Treasury Department.

3d. *The Geological Survey*.

4th. *The Survey of the Public Lands*, both of these last being under the Interior Department.

5th. *The vast system of Public Buildings*, embracing the erection and repairs of national edifices in the capital, and the building and repair of custom-houses post-offices, and court-rooms throughout the entire country. Most of this work is under the control of the Treasury Department.

6th. *The Meteorological or Weather Bureau*, in the hands of the War Department, because the idea of collecting and uttering the data originated in the brain of a clever army officer, who organized the Signal Service of the Army, and became head of a bureau for its administration.

7th. *The Agricultural Bureau*, belonging to the Department of the Interior.

8th. *The Bureau for the Administration of the Light-House System*, which is an appendage to the Treasury Department.

9th. *The National Observatory*, which, with its varied

duties, is assigned to the Navy Department; a disposition which could hardly be explained without going into a history of the passage of the law creating the bureau.

10th. *The Bureau of Patents*, one of the largest and most important of the administrative bureaus of the government. This is under the Interior Department.

11th. *The Inspection of Hulls and Boilers of Steamers*, under laws and regulations for the protection and preservation of life and property afloat; a branch controlled by the Treasury Department.

12th. *The Bureau of Pisciculture.*

Taken together, these bureaus perform a large and most important part of the administrative work of the government, and the duties are eminently scientific in character, though the range of scientific knowledge required for all is not great and is embraced by the course of studies of both of the national academies and many other insitutions of learning in this country. But, taking the bureaus separately, it will be found that with several the limits of duties are loosely laid down, causing an overlapping of jurisdiction, which brings about, in many cases, duplication of work, and engenders between rival bureaus strife and unseemly snatching for the congressional appropriations. A careful study of this subject brings to light a want of order and system utterly opposed to economy and efficiency. It would at once occur to any person of administrative experience that the first step toward reform would be made by consolidating all these scientific bureaus under one head, forming a new executive department, presided over by a secretary, who should be a member of the cabinet of the President Under such a system, with a complete set of regulations, and well-defined limits of bureau duties, all conflicting interests would at once die out and a harmonious whole be created.

[The political causes which have brought about and perpetuate so much confusion in our conduct of governmental public works are then pointed out, and the paper continues:]

It follows that some change is desirable in the method of carrying on our civil public works. As an example of continuous maladministration, take the class of public works coming under the head of "The Improvement of Rivers and Harbors." In opposition to the views of many able constitutional lawyers, and the early tenets of the Democratic party in its days of "strict construction," Congress finally assumed that money could be properly appropriated for such improvements under the clause of the Constitution giving to it the power to regulate commerce; and this one subject has now become of sufficient importance to justify the creation of a committee in the House of Representatives, having charge of this question and no other. Enlightened and conscientious legislation would at once have created an administrative bureau to carry on such works. To such bureau would necessarily attach so much prestige and authority that it would naturally become a guide to legislation in deciding what rivers and harbors were fit subjects for improvement, both in the interests of commerce and the national defenses. Its plans and estimates would be regularly submitted, and, works once begun, the appropriations should be continued to completion, and then the bureau should have supervision over them to prevent deterioration arising from wanton action or neglect. That was required from a business point of view. What is the history of this class of works?

Congress has retained, as it had the constitutional right to do, the selection of the localities to be improved. Appropriations have been made without the slightest regard to the merits of the question, but to conciliate the political influence of the localities. Appropriations have been made and works begun, and suspended because the appropriations were discontinued when the localities had lost their political influence, and thus money has been squandered. As a rule, the sums thus set apart have been given to the Corps of Engineers to expend, but the estimates from that bureau are never followed, and in many cases the Chief of Engineers has not authorized the expenditure of appropriations, made on a *pro rata* plan, because, being insufficient in amount for any beneficial purpose, the expenditure would be a waste of public money. Completed works are abandoned, and deterioration, from neglect and other causes, naturally goes on until such time as the local interests can, through their representatives, get new appropriations, far exceeding the cost of proper maintenance, had it been ordered. While, as has been said, custom has given these expenditures to the Corps of Engineers, Congress may at any time divert any or all of the items of the appropriations to any other bureau, or to any individual, for expenditure. It can, as it has done, direct contracts to be made with any specified individual, and can, as it has also done, on the application of such individual, modify a contract, to the detriment both of the people's treasury and the interests of commerce and navigation.

From the standpoint of a false political creed it is easy to see why Congress should have retained the selection of the rivers and harbors that were to be the objects of improvement, and why the evils described should have followed such action. If the sums of money absolutely squandered in those various ways should be collected in a table, the reason would be apparent why no subject annually brought before Congress produces so much stench in the nostrils as that same wasteful, log-rolling political job, the so-called River and Harbor Bill. Efforts have at times been made, perhaps not seriously, to get a sum appropriated in bulk, to be expended by the Corps of Engineers in such manner and on such works as might seem to be most necessary to commerce. No one can doubt that money so appropriated would be intelligently and honestly expended, but this would not effect the main purpose; and the efforts to change the policy of Congress have been invariably unsuccessful. The usual action of Congress on this subject has been so criticised by the independent press of the country that of late years some timidity has been shown, not so much in the character of the selections for appropriations as in the aggregate amount. It has been reserved for the Senate to adopt the brilliant method of adding largely to the items of the House Bill, and then reducing the aggregate, not by judicious elimination of improper items, but by reducing all the sums by twenty-five per centum, thus acknowledging the justice of the criticisms, but crippling works of incontestable benefit, while leaving intact the vicious principle. The Executive may sometimes have the opportunity to appy what known as the "pocket veto" to the bill, but he then takes upon himself the grave responsibility of suspending works of confessed public utility—a responsibility not assumed by him in the use of the constitutional prerogative. This portion of the civil public works adminstration certainly requires remodeling.

The work of planning, correcting, and repairing the public buildings of the nation is of great importance, and is conducted at great expense. No argument is needed to show that such work should be under one head, and that that head and all the supervising engineers and architects should be appointed on account of scientific and other qualifications, not political. The survey of the public lands of the United States has been carried on for years in an unscientific and primitive manner, and hereafter both law and science will be required to make straight the crooked paths. To sum up, there does not appear to be a single bureau under the general government, having charge of civil public works, in which the methods either of appointment or administration cannot be improved in the direction of economy and efficiency.

It is incumbent, then, on every one having an interest in the general welfare, and on those especially to whom the people have confided the legislative and executive functions of the government, that they devote to this subject time and study sufficient to evolve something vastly better than the present systems under which the work under consideration is accomplished. In looking into the practice of other nations, to aid in the solution of this problem, one naturally turns first to France, where the administrative ability is of a high order, and the systems more thoroughly elaborated, and perhaps more perfectly carried on, than with any other of the great nations of the world. There we find that the civil public works are solidly concentrated in one department, under the control of a cabinet minister, who is called the Minister of Public Works. These works are classified, and each class is placed under its proper administrative bureau. For instance, there is a bureau for rivers and harbors, another for roads and bridges, another for mines; one for light-houses, and one for the governmental supervision of the railways within the territorial limits of France; besides others, embracing in all the entire range of civil public works.

The duties of these various bureaus are executed by a Corps of Civil Engineers, forming a part of the permanent establishment of the government. The officers of this corps by their education are fitted to take charge of the duties under any bureau, and in their efficiency and capacity the nation has entire confidence. The existence of such a corps has settled forever in France the question of the method of carrying on works of public utility, and the ministerial Department of Public Works has outlived the various mutations to which the government itself has been subjected during the nineteenth century.

Such a system would naturally commend itself to any thinking person, but coming from such a source and with such a record as it has to prove its value, both as to efficiency and economy, the wonder is that a similar method has not long before this commended itself to some of our legislators and executives. We have, however, gone on as necessities have arisen, and added new bureaus of public works, assigning them, apparently by chance, to this or that executive department, till now there are few intelligent persons in this country who can tell what the divisions of such duties are and to what departments they belong. The reasons for the adoption and continuance of the present methods are undoubtedly:

1st. That the professional politicians would, under a better system, lose some of the patronage which falls to them in the bestowal of places at the incoming of every new administration; and no question of public good would overcome their opposition.

2d. In the various bureaus which now control the different classes of public works there is to be found a certain amount of political influence, which is and will always be zealously used to prevent the absorption of bureaus and the changing of the present status. Puny efforts, when aggregated into work in one direction, may make a very effective sum total.

3d. The old proverb, that what is the business of every one is the business of no one, applies here, and as yet no strong public man has felt called upon to make a chivalric attack upon the many-headed monstrosity which now passes as a system for carrying on the public works of this country. We have seen in late years, both here and in England, what has been accomplished by the persistent efforts of one man, or a small body of men, in the direction of true reform, and it is to be hoped that some one may yet don armor in this cause, against which no valid arguments can be brought, while on its side are to be found order, regularity, efficiency and economy.

Supposing such a system to be adopted, the question would at once arise, How shall this Corps of Civil Engineers be organized and how recruited? For the organization of the bureaus nothing can be better than to follow closely the French system, by classifying the kindred works under one head. Thus, all surveys and the work of the National Observatory would form a class of duties for one bureau. The light-house, the life-saving, and the meteorological system would fall together under another bureau. The supervision of railroads, and hulls and boilers of commercial steamers, might well be placed together. Public buildings would demand a separate bureau, as would also the improvement and care of rivers and harbors. There should also be a Bureau of Inventions, while agriculture and pisciculture would not be inharmonious under one bureau. This would give seven administrative bureaus for the civil public works, with infinite improvements in the simplicity of the work. The *personnel* of these divisions could be made up from the following sources:

1st. The many excellent officers of experience at present in existing bureaus.

2d. The great body of civil engineers of high rank and large experience, from which many could be selected who would take such honorable and permanent service.

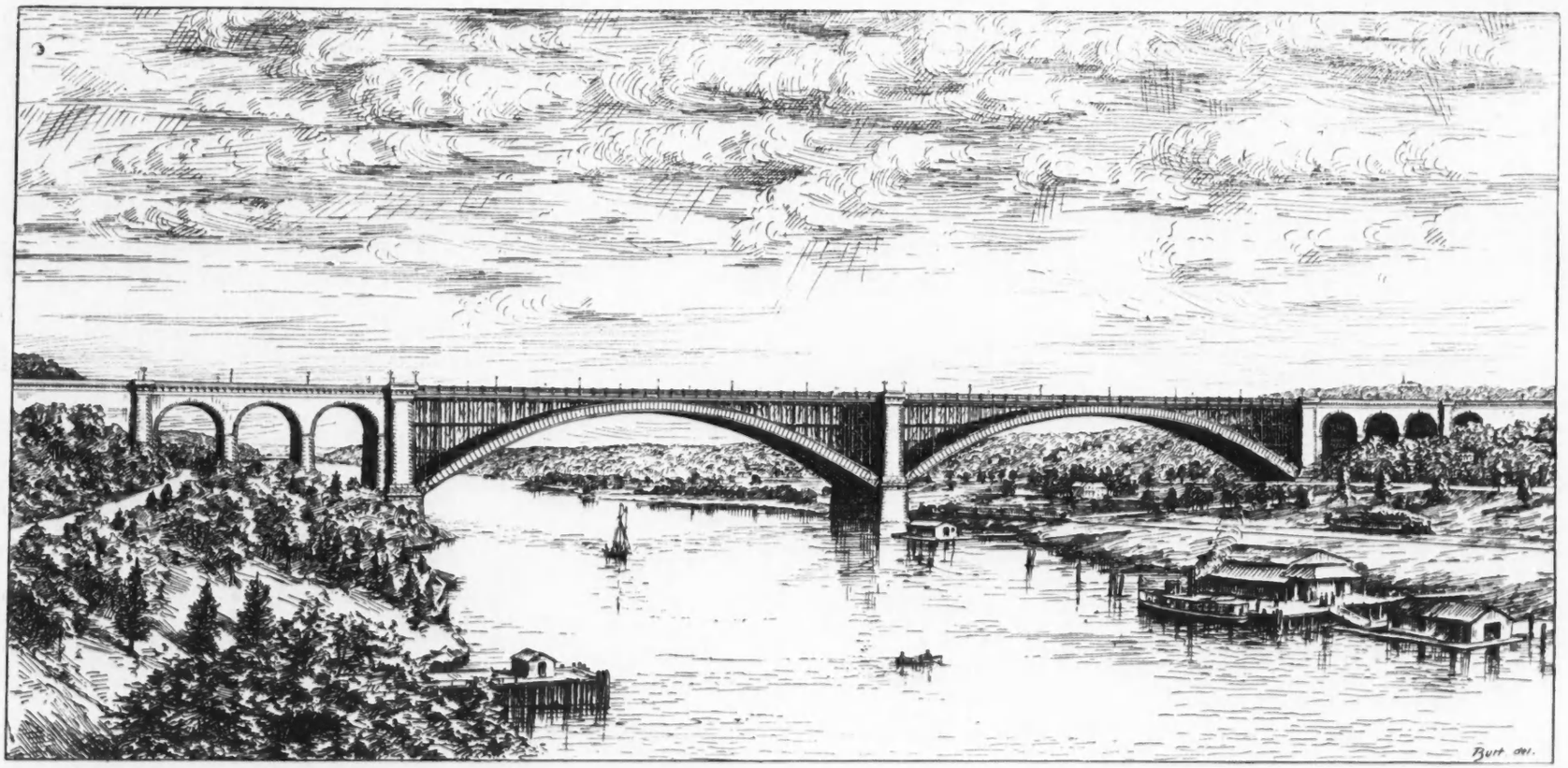
3d. The young officers of the Engineer Corps and of the Navy are eminently fitted by education and training for the discharge of duties under all the various bureaus, and many would willingly exchange for advancement into a permanent Corps of Civil Engineers.

4th. The educational facilities afforded in this country give yearly a large field for the selection of the subordinates.

Supposing such a system to be put in operation, how is it to be recruited as vacancies occur? The French have what may be called a finishing school, from which they fill the ranks of the Corps of Civil Engineers. That is to say, they have a standard for admission, both as to capacity and acquirements, and the selections for the government school are made from those who come up to that standard. The studies in this school are both theoretical and practical, and lead directly to the purpose in hand; that is, the fitting of the pupils for the discharge of any class of duties coming under the Department of Public Works. In addition to the scholars educated at the public expense, with a view to appointments in the Corps of Governmental Civil Engineers, the school receives, under certain conditions, those who pay a fee for tuition, thus acquiring an education second to none of its class in this world. The cost to the government of such a school would be but a tithe of what is now wasted on government works through ignorance, and the want of interest coming through a feeling of insecurity of position.

The French people cultivate carefully, as an important element in their entire range of administration, what is termed *esprit de corps*. This impresses upon each individual zeal in the discharge of duty, and a feeling that the general reputation of the corps rests in a degree upon the measure of his own success. In this country it exists in fragmentary bodies, and might be looked for as a natural result of the formation of a body of civil engineers for public works. However, when the law-makers of the republic see the necessity for consolidating the systems and simplifying the processes, the details of organization are matters that will offer no trouble in working out the problem of the administration of the civil public works.

GATEMEN on elevated roads get 10 to 12½ cts. per hour; ticket sellers, 15 to 18 cts. per hour.



THE MANHATTAN BRIDGE over the Harlem River at 181st Street, New York.

COMMISSIONERS.	ENGINEERS.	JOINT CONTRACTORS.	DIMENSIONS.	
JACOB LORILLARD	WM. R. HUTTON, Chief Engineer.	MYLES TIERNEY,	Extreme Length,	2375 ft.
DAVID JAMES KING	THEODORE COOPER, Consulting Engineer.	For masonry and substructure.	Width between parapets,	80 ,,
VERNON H. BROWN	WM. J. MCALPINE, Consulting Engineer.	PASSAIC ROLLING MILL CO.	Height of Roadway above Water	151 ,,
MALCOLM W. NIVEN, Sec'y.	ALFRED NOBLE, Resident Engineer.	For metallic superstructure.	Clear span of Steel Arches	510 ,,

ENGINEERING NEWS

VOL. XVII. Saturday, June 11, 1887.

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Mr. THOMAS C. CLARKE, of the Brooklyn Bridge trustees, and one of the Committee appointed by them on May 18, writes us in reference to that meeting:

"Nothing was done except to refer Mr. EMERY'S plan to a committee, with power to act. Your criticisms therefore are directed against something which has not yet been adopted."

The words of the resolution, as reprinted in full on page 360 of our last issue were:

Resolved, that the new work and alteration *contemplated in the report on terminus facilities just presented* (Mr. EMERY'S) be referred to a Committee to consist of Messrs. JAMES HOWELL, THOS. C. CLARKE and CHAS. MACDONALD, *with power to immediately proceed with the execution of the same.*

As no authority is given in this report to do anything else than "to proceed with the execution" of this plan, and as it was followed by the election of Mr. EMERY as Consulting Engineer, we are unable to see how this resolution could be interpreted as anything other or less than a positive adoption of the plan by the Board, and it has been so understood by the press, as well as, to our knowledge, some of those who are most immediately concerned. We are pleased to learn however, that one member of the committee at least takes a contrary view.

WE show this week the finally adopted and much improved plan of the Manhattan bridge over the Harlem river at 181st street. The contract for this structure was awarded on July 14, to the Passaic Rolling Mill Co. and Myles Tierney, joint contractors for the superstructure and masonry, for $1,210,000 for the metal work, and $845,000 for the masonry and foundations.

The contract was awarded upon a compromise plan, a view of which was given in our issue of April 10, 1886, and to which we objected at the time as lacking the finish in design required by the importance of the site and the credit of the city paying for it. In our issues of Feb. 20 and Feb. 27 we also illustrated the plan of Mr. C. C. SCHNEIDER, to whom the first prize was awarded by the Commission, and the second-prize plan of Mr. WILHELM HILDEBRAND.

We congratulate the engineers and the Commission upon the good taste shown in the present design and a comparison between it and h one originally adopted will convince our readers that there was abundant room for this improvement. Something more was demanded at this point than a mere iron framework and blank walls of masonry, which were about all here was in the plan bid upon.

As lately noted in our engineering notes, the foundations for the main piers are all in and the pier-masonry sufficiently advanced to commence the erection of the river spans and shore arches in a very short time.

BESIDES the extensive network which the Chicago, Rock Island & Pacific Co. is surveying and constructing in central and northern Kansas, two long extensions are reaching out to the southwest. The first of these pursues a diagonal direction across the State from Topeka, crossing into the Indian Territory in Seward county. It is generally conceded that the destination of this branch is El Paso, Tex., and that by construction or purchase a satisfactory connection will be made with the southern Pacific coast. The other line, which runs from Herington south through Fairmount, Wichita, Wellington and Caldwell, is now being located across the Indian Territory and will run directly to Fort Worth, Tex. By this brilliant move the Rock Island will secure a most important advance toward the Texas trade, of which Fort Worth is the key. It will be an even race between it and the Atchison, Topeka & Santa Fé as to which shall first own a through line from Fort Worth to Chicago. Between these points the latter company will have a considerably shorter line, but its competition will be little felt at more northern points. The Rock Island is the first of the great Northwestern systems to build into Texas, and will be the foremost to reap its share of the immense traffic, which is yet in its infancy, between the grain fields of the northwest and semi-tropical Texas. It calls itself still, "The mid-continental link between the Atlantic and Pacific," a reminder of the days when its main line was the only one from Chicago to Omaha, but it can soon fairly claim some more pretentious title.

THE following extract from a private letter from one of our most prominent mechanical engineers can hardly fail to be read with interest, as showing what neglected possibilities still remain in the way of handling trains.

"I am exceedingly interested in the matter of stopping short trains. We have made some tests lately that you would describe as "extraordinary! wonderful!" Imagine how surprised an engineer would be by a *whisper* that gives him information whereby, in handling a five-car train which at a speed of 45 miles an hour he can't stop short of 2,000 ft. on a grade, he suddenly becomes aware he can bring it to a stand-still in 900 ft. How is it done? Simply by (after having applied his brakes) promptly reversing his engine and opening the throttle wide. The excess pressure that is pumped into the boiler by reversing escapes through the safety valve before a sufficient pressure is reached to slide the drivers. If the throttle is not opened the drivers will slide every time and there will be considerable risk of blowing off the steam-chests. I am going shortly to show what a wonderful stopping power every engineer has in his reverse lever, judiciously handled."

WE have received several inquiries as to how to obtain the New York Commission report on the State bridges. The only way we know of is to send in *early* an application to the Commission for a copy when issued. These applications, we are advised, will be registered and filled so far as may be, in order of receipt, to the extent of the available supply, when the volume is issued, which will not be for some months yet. The edition will be very likely to be limited, and distributed for the most part through the "Members of the Haouse" to the intelligent country farmers and other people who care for the volume only as a tribute to their importance. The men who would really value, and use the volume will very likely find it difficult to obtain; but *advance* orders will very probably be filled.

WE devote an unusual space this week to a reproduction of the greater part of a pithy summary by Gen. WM. F. SMITH of the argument by a new Department of Public Works, which we find in *The Forum*. Gen. SMITH gives a list of twelve bureaus and sub-bureaus which are all of the same general character, in the sense that an engineering education and training is the best preparation for conducting them. Of these, 5 are now under the Interior Department, 4 under the Treasury, 2 under the War Department (including the most important of all) and 1, the National Observatory, under the Navy Department. No reason other than chance exists for most of these assignments, and that the public interest would be better served by consolidating them under a new Department of Public Works with a new cabinet officer at the head of it, we take to be undoubted. The only difficulties are the two great ones of perfecting the details of such an organization so as to overcome legitimate objections, and of overcoming the vast aggregate of political pressure which would result from those interested or believing themselves interested in maintaining the established order of things. Once organized, the Public Works Department would become one of the most important of them all, and its organization can hardly be many years delayed, since the vast expansion in the work of all our governmental departments makes a more accurate subdivision of the work under at least one more cabinet officer highly expedient. There is a certain obvious absurdity in having two cabinet officers for carrying on wars, in which we do not engage, and not even one for supervising the works of peace in which we do engage, largely and constantly.

Gen. SMITH'S plan is to copy almost exactly the French system, to have a permanent Corps of Civil Engineers, and to have no civil works carried on by officers detailed from the military departments, unless by permanent exchange therefrom into the corps of Civil Engineers. Immense advantages would result from the organization of such a department, if once properly organized, but great care would have to be taken to prevent positions from becoming too permanent, regardless of merit. Permanent military organizations are the growth of centuries of experience and answer well their special purpose. *Live* organizations of the same kind for the works of peace are a modern necessity, and such experience as is available in France and otherwise we do not understand to be altogether admirable as a model.

IN 1856 the world's production of pig iron was 7 million tons, in 1875, 15 millions, in 1883, 21 millions. During the last twenty-one years Great Britain increased its production of pig iron from the first year named in the table to the highest annual product, 76 per cent., the United States 456 per cent., Germany 237 per cent., France 64 per cent., Belgium 64 per cent., Austria-Hungary 152 per cent., and Sweden 53 per cent. Next to the United States, Germany has made the greatest relative progress in this period in the production of pig iron. The country which has experienced during the past few years of general depression the most serious check in the growth of its pig iron industry is Great Britain. It is probable that the United States will pass her as an iron-producing country about 1890. An elaborate English resumé of "The Mineral Resources of the United States," in which these figures are quoted, comments as follows on the last statements:

"The nations that need supplying in the immediate future, in the Eastern hemisphere as well as in the Western, may find that England can best supply them, as she has more power and influence and association with them, and England, as an iron-producing nation, may yet lead the way, *even if her sons are not half as selfish, self-seeking, protective, or prohibitory in their fiscal actions as their neighbors.*"

A nation which can relish and swallow this sort of pap about its own virtues——so transparently silly that it should not impose upon a child——may have a great past, but it has no future, and if it were not relished it would seem as if so much of it would not be published. The lion masquerading in the ass' skin of philanthropy seems an ass indeed, but not exactly the kind of ass that he intends.

Sir I. LOWTHIAN BELL, at the last meeting of the Mechanical Engineers, renewed the discussion as to why American engineers prefer to build locomotives with steel or iron fire-boxes at 4.88 cts. per lb., while English locomotives with copper fire-boxes, as built at the London, Brighton & South Coast Railway cost 11.14 cts. per lb.—and hardly make half the mileage per year—or haul much more than half as heavy trains, we may add. Sir LOWTHIAN deems this especially peculiar, since America exports copper which it will not use for that purpose, while England has to import her copper while she exports steel.

A very learned discussion followed, very learned indeed, the chief burden of which was that it was because Americans preferred cheapness to durability—and the Englishman didn't. This explanation was not swallowed throughout all England, however, for its absurdity was transparent enough to be seen through by at least one technical editor, who admits in a large-minded way:

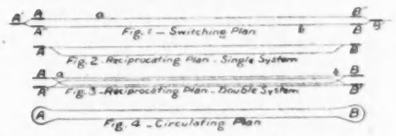
"But even this does not account for the universality of the use of copper in England and of iron or steel in American, for in this country cheapness is *sometimes* demanded, and in that, endurance and efficiency are *occasionally* desired at whatever cost."

It is, indeed. There are people, and there are roads in this country, that are always ready to pay for "endurance and efficiency" whenever it does not cost more than it is worth, and who always have the ready money in their pocket to do it with. Over and over again, we may add, this class of people have tried the copper fire-boxes in this country, but only to abandon them.

The true explanation is to be found in a recent elaborate and able paper by Mr. WM. STROUDLEY, the Locomotive Superintendent of the road above referred to, whose engines cost 11.14 cts. per lb. By referring to the latter part of that paper Sir LOWTHIAN will find that the effect of those copper fire-boxes is to enable the boilers to develop nearly 101 per cent. of the theoretical efficiency of the fuel consumed, for the figures are there to prove it, and the engines have a further remarkable peculiarity, that the power transmitted to the draw-bar in a 50 mile run averaged about 100 per cent. of the indicated horse-power of the cylinders. These advantages are cheaply purchased by a few pounds of copper.

The Brooklyn Bridge Problem.

The important engineering question which we discussed at some length in our last issue under the above head, necessarily has many sides, all of which it was impossible to touch upon in a single article. Therefore, as will be readily recalled by careful readers, we confined our discussion to the simplest and least dangerous side only of Mr. EMERY'S plan, viz., that in which there is only a single reciprocating system, Fig. 2 (reproduced from our last issue). These dangers alone are enough in our judgment to make the proposed system an improper one, and we therefore did not even allude to the additional complications and dangers which would result from the double system, Fig. 3, which must be immediately adopted to even approach the present capacity of the bridge, for the assertion in Mr. EMERY'S report (p. 361 of our last issue) that "*it is a fact, however, that half of the proposed system would have more capacity than the present arrangement*," is an entire mistake, as we showed last week. On the contrary, it

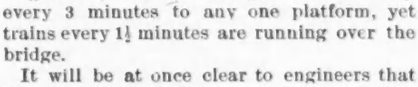


cannot possibly be made to give more than two-thirds of the present capacity with four car trains.

In considering only a single reciprocating system, Fig. 2, we necessarily assumed that trains were run at only 3 minute intervals on this system, instead of the present 1½ minutes, and showed in detail by figures that oblique head collisions similar to Fig. 6, must result

from *three minute* intervals, whenever 2 to 10 seconds more of time was lost than now frequently occurs. In other words, we considered only the dangers which cluster around the point *I O D*, Figs. 5 and 7, with trains *half* as frequently as now. In the complete system, Figs. 3 and 7, these trains between one pair of platforms, say the north one, *A B*, Fig. 3, are sandwiched in between other alternating trains, so that, although trains run only every 3 minutes to any one platform, yet trains every 1½ minutes are running over the bridge.

It will be at once clear to engineers that there must necessarily be more inconvenience



and danger in operating a double system of this kind, Fig. 3 and 7, than in operating only a single system with half as many trains, Figs. 2 and 6, and the dangers of the single system being quite enough, we deemed that the greater dangers of the double system need not be pointed out to intelligent and careful readers. It is therefore with no small surprise that we find the following misrepresentation of fact in the opening paragraph to a a brief interview with Mr. EMERY, reported in last Sunday's Brooklyn *Eagle*:

"The writer of the article errs in considering at length only one-half of the proposed system, that is, of starting all the trains from one track, loading cars from a platform on one side and unloading on the other. This plan was considered at first as a means of operating the bridge railway temporarily only, while the two starting point system was in process of construction, but it was abandoned as unnecessary when it was found that two tracks could be put in without interfering with the travel."

A few lines below the further statement is made:

"The article does not seem to take into consideration the fact that a train at rest can never be in the slightest danger from a train going to the other track, as the waiting train would not be started until the other had made the crossing, and that the time between trains on the same side of a double starting point system is three minutes instead of one and one-half minutes. That this has been lost sight of is more evident from the fact that the writer of the article leans to still a third plan of his own in which the cars are to be run around a circle at the terminus without any switches."

In view of the fact that we did not even hint or allude to any danger from "trains going to the other track" but confined our attention exclusively to the danger at *I O D* outlined in Figs. 5, 6, 7, it would be difficult to more completely and more unfairly misstate our position. The only words in our article which could possibly be twisted into such a sense were these:

"Mr. EMERY'S plan amounts to an oblique railroad grade crossing to be used at full speed every three or four minutes by trains only a few seconds apart from each other. Under far less exacting conditions long experience has shown that the only way in which such crossing can be made safe is by automatic interlocking home and distant signals *and* derailing switches, to throw the train off the track if both these signals are run by, as they not unfrequently are by the most careful men."

As was clear from the context the reference here was solely to the point *S I D O*, Fig. 7, which will be recognized by railroad men as "amounting to" a crossing, since trains are to whiz by each other there at full speed. Put another switch back of *S* and the crossing would be complete without modifying the sources of danger. The crossing at *C* does not "amount to" a crossing, but is a crossing, and was nowhere alluded to.

As Mr. EMERY writes us that "the *Eagle* interview contains many errors in words and figures," and as we cordially agree with him, we need not discuss it further, except to add its closing sentence, which demands a word of comment:

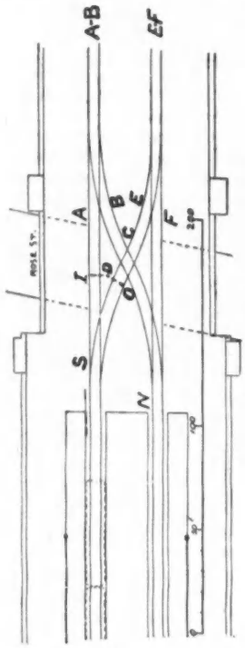
"The writer of the article has evidently been biased by the desire to introduce something of his own of entirely novel character, so the criticism cannot be considered as having the weight it would otherwise have in an engineering journal."

Leaving the truth and propriety of this allegation to the judgment of our readers, we have only to add that facts are facts, and arguments are arguments, by whomsoever presented and with whatever motive. Aspersion of the motives of those who present them is not an answer to them, nor can we perceive how it weakens the force of an argument against a given plan that its author believes, as we admit that we do, that three or four times as much can be better accomplished in another way. The objections which we have so far raised against the proposed plan have been positive; that it was objectionable in itself, so that it was better to make no change whatever from the present system, but the allegation of interested motives has at least had this much effect, that it has decided us to continue to waive all consideration of any third plan, and rest our objections to the proposed plan solely on the ground that it is better to do nothing than to adopt it.

The comparative capacity of the double reciprocating system admittedly, is as nearly as may be, double that of a single reciprocating system, but as we stated last week, this amounts to only 28½ per cent. more than the present single system with 4-car trains. How the erroneous impression has arisen that a very large increase of capacity would result, is easy enough to see. It appears self-evident that twice as many trains can be dispatched from two platforms as from one platform, and also that 50 per cent. more passengers can be carried in a 6-car train than in a 4 car train. Then we have, apparently, $2 \times 1\frac{1}{2} = 3$ times as much capacity by the new 6-car trains from two platforms against the present 4-car trains from one platform. This is the hasty reasoning which has deceived the Brooklyn public, and apparently the bridge trustees, but when we analyze the problem, we find that it is only possible to run the 6-car trains at 3 m. 30 sec. intervals from one platform, or 1 m. 45 sec. intervals from two platforms, so that we have 6 cars every 105 seconds, or 1 every 17½ seconds, against 4 cars every 90 seconds, or 1 every 22½ seconds, by the present plan; a gain of only 28½ per cent.

The dangers of the complete double system, however, (Figs. 3 and 7) are very much greater in the aggregate than we have yet shown, for if we analyze them, we shall find that there

are in the complete system, the following nine elements of danger, only one of which we considered; all of them being matters of considerable, though varying importance, *and all*



[Although this cut is made directly from the plan accompanying Mr. EMERY's report it is imperfect in this, that the complete plan proposes to have the tracks *B* & *E* run completely across the bridge independently of the tracks *A* and *F*; so that there will be two rails side by side at *A-B* and *E-F* where only one is shown. Fig. 3 makes the principles of this clearer.]

Fig. 7.

of them new ones, since they do not exist at all in the present system, or in a continuous circulating system:

1. Danger of oblique head collision at *I O D* between trains 3 minutes apart considered last week, and the most serious single danger).

2. The corresponding danger on the south track.

3. Danger of switch derailment from the "facing points" at *S*, while gripping the cable.

4. The corresponding danger at *N*.

5. Danger of crossing collision at *C* between trains for different platforms.

6. Danger of frog derailment from the *two* frogs in the north track, those for the switch *S* and for the crossing at *A B*.

7. The corresponding danger of frog derailment from the two south frogs.

8. Danger of crossing frog derailment from the four crossing frogs at *C*, passed over once by every train that enters the station, or once every 1½ minutes.

9. The additional complications and dangers from the fact that the entire handling of the trains over these frogs, switches and crossings is proposed to be by cable, against which is to be balanced as partial compensation (and in our judgment a very partial one) the fact that the trains consist of cars only.

Every one of these dangers are very real ones indeed, such as no railroad man, nor engineer of maintenance of way, dreams of making light of, even under the far less exacting conditions of ordinary practice. Accidents are constantly occurring from every one of them, on roads where trains are separated by more hours, than they are here by minutes.

Consider, for example, the facing point switches, *S* and *N*. They are always dangerous, so much so that on well managed double track roads they are forbidden. Accidents innumerable have happened from them in various ways. They break; they move under and "split" a train, so that half of it goes one way and half another; they fail to come to a safe bearing even without apparent obstruction, or jar free just as a train approaches; more commonly than all, they are obstructed, by snow, or stones, or blocks of wood, or of irons. In all interlocking apparatus they must be shut and locked before a safety signal can be given. Such we may assume will be used here, but unfortunately the brakemen and grips and cable cannot be interlocked, nor is it usual to interlock the signal bell for starting. Supposing a train has gripped the cable and started, and takes the facing points wrong, or is in any way derailed at them? What is going to happen, with the train going one way and the cable the other? Something very unpleasant and quite different from the ordinary derailment, we may be sure. How much more serious the danger is with a cable than with locomotive power should not need pointing out.

Again, frogs are an incessant source of additional danger, both from breakage and from obstructions, and we may add from derailments at them without any apparent cause. The danger is a very small one indeed to any one train, but with so many trains and so many frogs and so many chances for accidental or malicious obstruction the additional danger is by no means a light one, especially as a sudden derailment will be so apt to bring about a collision as well. A very small obstruction in the throat of a frog will throw a train off the track, and here are sixteen frogs introduced on this mile of road, besides those which may be required to get locomotives on and off the track. If there were 16 frogs to the mile between Chicago and New York, we may be quite certain that frog accidents would rise to a very serious total. At present the railroads of the United States will average considerably less than one main line frog to the mile, we apprehend.

Finally, there is the danger of crossing collision at *C*, Fig. 7. This is not nearly so great as at *I O D*, Fig. 5, and yet, no one with a proper idea of the situation will make light of it. It is passed by two trains every 3 minutes, by Mr. EMERY's plan, each train taking $3.4 \times 6 = 20\frac{1}{2}$ seconds to cross. That is to say, for 41 seconds in all out of every 180 seconds, or nearly one-quarter of the time this crossing is to be occupied by trains. With locomotive power, which brings both trains under complete control, this is rather lively work, but in operating by cables both trains pass this crossing practically "beyond control" in the technical sense of that expression; *i. e.*, beyond ready and quick control by a single man (the locomotive engineer) in a position to see what he is about. The conditions are fairly comparable, therefore, only with an ordinary crossing on "the open road" between stations. Suppose that just before an incoming train "clears the crossing," the other is in the act of "actually starting" by applying the grips, (as has been unnecessarily suggested will be the regular system of operating,) something happens to the incoming train, or a man falls onto the track in front of it, and the train must suddenly be stopped? Perhaps the grips may be released in time and perhaps not, but it depends only on human presence of mind to do it, and railroad men who have had to do with human presence of mind, do not place any great reliance on it when they can possibly avoid it. In time, as the employés grow careless from long immunity, accidents would be very probable indeed, even at this crossing, especially in fogs.

We have left ourselves no space to speak of the proposed roadway cable cars, nor does it appear necessary to do so, since the objections to that plan can be weighed by anyone, whether an engineer or not, who will take the trouble to consider how much too wide a double 18 ft. roadway is for the natural wagon traffic between two cities like New York and Brooklyn.

With this we leave the subject to the consideration of the powers that be, trusting that they will remember that the Brooklyn bridge is the front door to the city of Brooklyn, and that projects for radical changes in it should be first well considered, and not rushed through with a hurrah. The importance of the problem alone should "give us pause, and make us rather bear the ills we have, than fly to others that we know not of."

CORRESPONDENCE.

The Connection of Lightning Rods with Water Mains.

HOLYOKE, MASS., May 24, 1887.

EDITOR ENGINEERING NEWS:

Please inform me either by letter, or through the columns of your paper, whether or not the connecting of lightning rods with water mains would be likely to cause damage to the mains.

Yours very truly,
E. P. CLARK, Registrar.

[We publish the above in the hope that some one having practical experience in this direction will answer Mr. CLARK's query. While we have no personal experience, we should say that the extent and nature of the conductor would be sufficient to distribute the electrical fluid without damage to the mains. The only water mains we ever heard of as being injured by lightning were cement-lined wrought-iron.—ED. ENG. NEWS.]

A Claim for the Invention of Driven Wells.

KANSAS CITY, June 3, 1887.

EDITOR ENGINEERING NEWS:

Noticing some recent discussions concerning driven wells, I would respectfully present my claims as the first inventor of this device. Although being a boy at the time, I didn't know that I had done anything remarkable.

In 1846 or '7 a steam mill was built in La Fargeville (Jeff. Co., N. Y.) Being the first engine I had ever seen I was an interested observer, and from my acquaintance with the proprietors, was allowed liberties not accorded to my playmates, to study its operation.

The suction pipe to the force pump gave trouble from the sawdust, and the water being shallow, it was hard to prevent its accumulation around it.

The end piece of the pipe (cast-iron) was drilled full of small holes, about ¼ in., I put strips of wood between the flanges, and wound the whole with fine wire cloth, two thicknesses—using two thicknesses because I thought that the cloth was not fine enough in one thickness to keep out all the sawdust. After this was put in there was no more trouble and the sawdust was allowed to accumulate around the pipe till it came above the surface of the water.

I do not know the text of the patents, but from what I have heard, it seems to me that this, when the sawdust had reached above the water, became in effect a driven well, I recollect it being considered a curiosity at the time.

I have used the same device, or its equivalent frequently since, on two other mills before the war (of 1861.)

This may be too late to have any bearing on the case before the courts, but if it has, the facts here stated can be proven.

Respectfully, G. W. PEARSONS.

Bags for Cement.

PITTSBURG, May 25, 1887.

EDITOR ENGINEERING NEWS:

In your issue of May 21, 1887, you have an article entitled "Bags *vs.* Barrels for Cement." I have had some experience in the handling of cement delivered in both kinds of packages.

In this section we can buy cement from 25 cts. to 30 cts. a barrel cheaper in bags than barrels. The manufacturer puts cement up in two kinds of bags, paper and cotton. If cement is sent in paper bags there is nothing to return to the manufacturer; if sent in cotton bags the bags must be returned to manufacturer, and value credited to contractor.

In your article you seem to miss what, to my mind, is one of the important features in the case, viz., the cement, when delivered in cotton bags, sifts through onto the men and, in hot weather, when the men perspire freely, the result is as if the hands were put into lime, but in a less degree.

The men naturally object to this, and insist on increase of pay for handling cotton bags.

This increase, of course, is to be deducted from the saving. In cold weather this is not so objectionable as in warm.

The bags are about the size of the usual meal bag, and will contain about ⅘ bls.—say 200 lbs.

After the cotton bags have been used several times, while they appear to be good, they get rotten, and in handling are very apt to break.

The cement manufacturers always use the bags as long as possible, for if they break in the hands of the contractor, and he fails to return them, he must stand the loss.

The paper bags are much better, as they are only used once, and, if made of good material, in the first place, will not, with reasonable care, sift cement through or break, and as they weigh less per package than either cotton bags—or barrels—the men prefer handling them.

Another disadvantage of either kind of bags is, that the cement in barrels, if laid on their side, and covered with a few rough boards, are practically water-tight for a reasonable length of time; whereas, for bags, sheds must be built, the cost of which must also be deducted from the saving.

In many cases, it costs more to *carry* a bag, than to *roll* a barrel. Undoubtedly, the *first* cost of cement in bags, is the cheaper, but when handling, storing, waste, etc., are added., the cement in the work, delivered in barrels, is often the cheaper.

Yours truly, J. H. H.

Wire Fence in the West.

CANASTOTA, N. Y., June 7, 1887.

EDITOR ENGINEERING NEWS:

In your issue of June 4, you ask for answers to D. C. KASEMAN'S inquiries for price paid for railway fence in the west. I may be able to give some information, having made railway fencing my business for several years, though not so much in the west as in New York State, and the south. Wire plain and barbed (mostly barbed) is the material generally used by railway companies, it being cheaper, and more durable than boards. Wood posts are used almost entirely, and vary in price according to distance shipped, etc., the cheapest (chestnut, oak and soft cedar) costing from 10 to 25 cts. each. Many kinds of iron posts have been tried and found wanting. If enough iron is used to make a large and substantial post, the cost is too high; I know of no terra-cotta posts in use. There is one made of a combination of iron and clay, and several of cement or artificial stone, but none have been used to any large extent.

A new post that has attracted considerable attention, is made of a galvanized sheet iron shell filled solid with concrete or artificial stone, which when properly hardened and set has the appearance, and it is claimed the durability of solid iron. A fair price for furnishing the material and building, say 50 miles or more of common four strand wire fence on good ground and on posts set 3 ft. deep, and one rod apart and costing say 15 cts. each, would be from $200 to $220 per mile complete.

A four strand fence with posts 8 ft. apart, and 2 x 4 cap, spiked to top of posts with beveled and painted joints, about 50 to 60 % more than above price. A contract was let recently in Ohio for building 63 miles, with posts 11 ft. apart and 2 x 5 cap piece, for $250 per mile, but is considered a very low price. The bids ranged from this to $500 per mile. Common board or "woven picket wire fence" with posts set 8 ft. apart, $350 to $400 per mile. These prices are figured on good material and the best workmanship. We are now engaged in fencing the Canastota Northern Railway, and are using four strands of galvanized, thick set, steel glidden barbed wire on chestnut and oak posts set one rod apart.

Yours truly,
A. A. PARKER, Fence Supt.
Washburn & Moen M'f'g. Co.

PERSONAL.

MRS. FRANK THOMSON, wife of the First Vice President of the Pennsylvania R. R. Co., died at Elberon, N. J., June 2.

MRS. S. D. MASON, wife of the Principal Assistant Engineer, Northern Pacific R. R., died May 26 at St. Paul, Minn.

H. G. HOLDEN, Superintendent of Water Works, Lowell, Mass., has accepted a position as General Superintendent with Messrs. Turner, Clark & Rawson, of Boston.

F. A. GARVEY, Chief Engineer of the Texas & Pacific R. R., has resigned his position, and will engage in contracting and railroad construction with his brother.

WILLIAM JACOMB, late Chief Engineer of the London & South Western Railway Co., died suddenly on May 25, aged 54. He was a pupil of Brunel, had charge of the building of the *Great Eastern*, and later turned his attention solely to railway engineering.

COL. JAMES ANDREWS, of Allegheny City, Pa., will probably be chosen to succeed the late Capt. EADS as Chief Engineer of the Tehuantepec Ship Railway project. Col. ANDREWS is at present in Mexico, but will arrive home in a few weeks, when steps will be taken to secure his services.

REUBEN WELLS, General Manager of the Louisville & Nashville R. R., and formerly Superintendent of Machinery of that road, has accepted the position of Superintendent of the Rogers Locomotive Works, at Paterson, N. J.

CHAS. S. CHURCHILL has resigned his position with the Pennsylvania Schuylkill Valley R. R., and has accepted the position of Engineer of Maintenance of Way on the Shenandoah Valley R. R., with headquarters at Milnes, Va. He will enter upon his new appointment on June 15.

J. M. PHILLIPS, Master of Transportation on the Gulf, Colorado & Santa Fé R. R., has been appointed Superintendent, and J. W. CLARKE has been appointed Engineer in Charge of Roadway, Bridges & Buildings. W. J. SHERMAN, Assistant Chief Engineer, will give his entire attention to the construction of the new lines.

MR. GILMAN TRAFTON, for many years Engineer of the Louisville Bridge & Iron Co., at Louisville, Ky., and a member of the American Society of Civil Engineers from Jan. 4, 1871, up to the end of last year when he resigned on account of ill health, died on May 25.

CAPT. C. B. PERCY, Assistant Engineer, Mobile & Birmingham R. R., has accepted the position which he formerly held as Assistant Engineer under Major A. M. DAMRELL, U. S. Engineer Office, Mobile, Ala. Capt. PERCY will proceed to make a complete survey of the Warrior river from Tuskaloosa to Demopolis.

A. A. HESSER, Superintendent of the Mahonoy division of the Philadelphia & Reading R. R., has been promoted and is succeeded by C. M. LAWLER, formerly Division Superintendent of the Chicago & Northwestern R. R.

CHANGES OF ADDRESS, MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

FRED. H. BALDWIN, Principal Assistant Engineer, Union Elevated R. R., 31 Sand street, Brooklyn, N. Y.

A. J. CHAPHE, 917 Primrose Street, St Louis, Mo.

GEORGE A. LEDERLE, Resident Engineer, Willamette Bridge, Portland, Oregon.

FRANK L. GRISWOLD, 80 Calle Constitucion, Cordoba, Argentine Republic.

GEORGE W. PLYMPTON, 127 Herkimer street, Brooklyn N. Y.

W. B. RUGGLES, Engineer Second Division, Louisville Southern R. R., Harrodsburg, Pa.

TECHNICAL NOTES.

THE *Queen Victoria*, a new Liverpool and Isle of Man steamer, lately made the trip in 9 hours, 23 min. actual steaming time. This shows a speed of nearly 22¼ knots, or 25.62 miles per hour; a speed only excelled by the latest torpedo boats.

THE Santa Fé railroad has equipped its Topeka and Kansas City accommodation train with electric signal bells and an electric attachment for releasing the air brakes. The Westinghouse brakes sometimes stick to the wheels; but under the new arrangement the brakes can be released instantly by the engineer touching an electric button. Another electric system has also been arranged to take the place of the bell-cord. The conductor can touch an electric button in any of the coaches and it blows a small whistle in the engine. The engineer touches a button in the cab, which rings a small bell in all the coaches, signifying that he has heard the signal. All the passenger trains on the system will be equipped in the same manner.

WM. C. KLEMME of St. Louis, Mo., just received letters patent on a contrivance for switching grip-cars, to improve on the present clumsy terminals of cable roads. His plan does away with pushing the grip-car by hand and claims to obviate the necessity of loops. The scheme is to have the cable run outward from the frog to a wheel, and thence back in a diagonal direction to the return track. The momentum of the grip-car will carry it across the frog, when the grip will then immediately connect with the returning cable and the switch be made with perfect ease and swiftness. Mr. KLEMME'S patent has already been accepted in Chicago, and is under investigation in St. Louis.

IN 1885, 15,000 miles of Russian railways consumed upwards of 575,271 cu. ft. of wood, 32,000 tons of peat, 60,000 tons of liquid fuel and 1,200,000 tons of coal, all but 200,000 tons of the latter coming from the South Russian collieries. Nearly 80,000 acres of forest have been demanded to furnish wood for railway fuel, and its use is decreasing yearly, being now replaced by coal and oil.

Messrs. FORREST & Co. made for Mr. STANLEY in his present expedition for the rescue of Emin Pacha a sectional boat that is illustrated in the *London Illustrated News*. This boat is made of galvanized steel and is divided at right-angles to its axis into 12 segments each weighing 77 lbs., and when wanted for use is bolted together by flanges with a strip of rubber between each segment to make it water-tight. The boat is about 28 ft. long, 6 ft. wide and 2.8 ft. deep. Each segment is provided with a stationary seat which serves as a brace while it is being carried overland suspended from a pole between two men.

A PHYSICIAN sends to the *Medical Record* the following remedy for the intense itching caused by ivy poisoning, which may be convenient for engineers engaged in field-work; Bromochlorolum, 4 parts, vinum opii 2 parts, water, 6 parts. Used freely as a lotion it "acts like magic" in relieving the itching, as also in "urticaria."

A VERY important part of the outfit for field-work is water-proof boots. The following recipe gives a boot-grease "as is," which adds much to the comfort of a party, if regularly used:

4 oz-Neatsfoot oil.
4 oz-Fish oil.
4 oz-Mutton tallow.
1 Table-spoon full of ivory-black.
Burgundy pitch size of a hickory nut.

Melt the tallow first and add the oils. When heated, put in the Burgundy pitch, and set aside to cool. Just before congealing, put in the ivory-black. Care should be taken not to burn the tallow and oils.

THE London *Architect* gives notes as to estimating the probable cost of large buildings by a rate per cubic foot. It is commonly taken that one shilling per cubic foot is a fair price for London buildings. The Home and Colonial Offices in Parliament St. cost 11$\frac{1}{4}$*d.* per ft., measuring the 12 ft. of concrete laid over the whole of the site; or 1*s.* 0$\frac{1}{4}$*d.* per ft. if the concrete was excluded. In late estimates for the War and Admiralty buildings, the basement was estimated at 9*d.* and the superstructure at 1*s.* per cu. ft. But later examination and evidence prove that the shilling rate should apply to the whole building, as the tower and part of the building above the roof would cost 1*s.* 6*d* per cu. ft. This shilling rate per cubic foot agrees very closely with the 25 cent rate usually adopted in the United States for a good class of buildings.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—*Annual Convention Arrangements.* The Annual Convention for the year 1887 will begin at New York City, July 1, 1887. Members who can conveniently do so, are invited to meet informally at the Society House, 127 E. 23rd, St. New York, on Thursday evening, June 30th.

On Friday morning, July 1, a steamer of the Albany Day Line will be taken at the foot of West 22d St. New York. The party will proceed by steamer to Rondout and thence by the Ulster & Delaware R. R., the Stony Clove & Catskill Mountain R. R., and the Kaaterskill R. R., to the Hotel Kaaterskill, Catskill Mountains, N. Y., arriving in the afternoon. Tickets purchased and baggage checked on boat direct to the hotel; baggage to be plainly marked with name of owner.

An excursion will be made during the week beginning July 3, to visit on invitation of the Union Bridge Company, the Poughkeepsie Bridge and the City of Poughkeepsie. An excursion will also be made to the Cement Works and Quarries of the Rosendale Cement Rock at Binnewater, on invitation of Mr. F. O. NORTON, F. Am. Soc. C. E. The Fourth of July will be spent at the Hotel Kaaterskill, where in the evening there will be fireworks and a ball. On the evening of one of the other days of the Convention there will be a banquet. The President of the Society, WM. E. WORTHEN, Esq., will deliver the Annual Address at one of the sessions. The arrangements made provide for return to New York on Friday, July 8.

The arrangements secured for transportation to New York and return are at the rate of two-thirds fare for the round trip. In order to secure the benefit of these arrangements the instructions continued in that circular *must be strictly followed.* Those who find it impracticable to join the party on the morning of July 1, can proceed from New York either by rail direct, or *via* the Hudson River, to the Hotel Kaaterskill at any time. As the summits of the Catskills are usually cold during hot weather it is advisable to come provided with warm outer garments.

Members of the Society are particularly invited to transmit to the Secretary papers they are willing to present at this Convention, in order that a place may be given in the programme. The families of members are invited to accompany them to the Convention. The rate at the hotel will be $3.00 per day. The probabitity seems to be that this Convention will have a very large attendance from all parts of the country.

WILLIAM G. HAMILTON,
STEVENSON TOWLE,
JOHN BOGART, } *Committee.*

In addition to all the papers published during the last year, the following papers, not yet published, are also opened for discussion. Proof slips or abstracts of either of these will be sent to members who desire to discuss them.

A Masonry Dam; JOHN W. HILL.

On the Calculation of the Mean Horse Power of a Variable Stream, and the Cost of Replacing the Power Lost by a Partial Diversion of the Flow; WM. H. GRANT.

Steel; Some of its Properties; its Use in Structures and in Heavy Guns; WM. METCALF.

The Brick Industry about New York City; CALVIN TOMKINS.

On the Calculation of the Stresses in Bridges for the Actual Concentrated Loads; GEO. F. SWAIN.

Formulas for the Weights of Bridges; A. J. DUBOIS.

Compressive Strength of Steel and Iron; CHAS. A. MARSHALL.

It is expected that the following subjects, most of them suggested by some of the papers published or received during the past year, will be particularly discussed, and communications upon these subjects are especially invited by the committee, viz.:

The Inspection and Maintenance of Railway Structures.
The Disposal of Sewage.
Recent Practice in Cable Railway Propulsion.

It is not intended to restrict in any sense the presentation of papers to the subjects above suggested. It is expected that papers on several interesting subjects will be presented.

Reports will be expected from the Committees on Uniform Standard Time; To Consider a Plan for Creating a Library for Joint Use; To Consider the Proper Relation to Each Other of the Sections of Railway Wheels and Rails; On the Compressive Strength of Cements and the Compression of Mortars and Settlement of Masonry, and those subjects will be discussed.

One or more meetings of the Committee on the Proper Relation to each other of the Forms of Rails and Wheels will be held during the Convention, at which it is expected that various statistical and other facts of importance and interest relating to that question will be presented, and all members of the society who take an interest in the matter are invited by the committee to be present and take part in the discussion, should they so desire.

Discussion is requested upon any of the above subjects by members who cannot attend the Convention. The Secretary will be glad to present these if forwarded to him previous to the Convention.

It is desirable that papers offered for presentation at the Convention be sent to the Secretary not later than June 25, so that proper attention may be given the subject.

Engineers' Club of Philadelphia.—Record of regular meeting. May 21st, 1887. President T. M. CLEEMANN in the chair; 33 members and 4 visitors present. There was some further discussion of the form and arrangement of the proposed U. S. C. and G. Survey Map of the Delaware and Schuylkill rivers near Philadelphia. The consideration of a resolution expressing the views of the Club was deferred till the next business meeting. The Secretary presented two communications from Capt. S. C. MCCORKLE, embodying the following data on Retardation of the Tide in the Vicinity of Philadelphia, etc.:

"Mr. H. L. MARINDIN, of the Coast and Geodetic Survey, gives a near *approximation* of the retardation of the tide in the frontage of Philadelphia as about five minutes of time to the mile; *i. e.*, if the time of high water was at a certain time at Fort Mifflin, the time of high water would occur five minutes later for each mile you proceed up the river.

"Mr. MARINDIN sends me a little sketch, which I enclose, which shows the time it takes the tidal wave to traverse one nautical mile in the different depths of water. For example, in a bay with 60 ft. of depth of water, it just takes two minutes for the wave to go one mile. Mr. MARINDIN also says, 'The time of high water and low water at any place can only be determined by a long series of observations, and when the observations are taken simultaneously they have to be worked up separately, and it is a long job.'

"There has been a long series at Fort Mifflin, and the engineers of the United States have a long series at Bridesburg, but aside from these two places I do not think there have been observations enough to determine what you want. I deduce from the observations and conclusions that, say at Market Street Bridge, Schuylkill, the tide would be 40 minutes later than at Fort Mifflin, and at Bridesburg, on the Delaware, just about one hour later than Fort Mifflin.

"Bench-mark at Gloucester, N. J. (C. S. Report, 1870). 'The bench-mark is the centre of a triangle cut in a large block of granite which lies in a granite wall against the river. It is on the river side of the wall, about 50 yds. southward from the mark on the northwest corner of the Buena Vista House. It is 7.89 ft. above mean low water, 1.62 ft. above mean high water.'

"'The mean level of the Delaware River at Gloucester Ferry, from August 16th to Sept. 8th, 1870, was 3.3 ft higher than the mean level of the sea at Keyport, N. J' (Office data)."

The Secretary presented, for W. L. HOYT, a Multiplication Table, from 1 to 25, for the Reference. Book. Mr. JOHN L. GILL, Jr., presented an illustrated discussion as to Whether the Custom of Upsetting the Ends of Bridge Rods should be abandoned. Mr. ARTHUR MARICHAL read an illustrated paper on the "Construction of Reservoir Walls."

Mr. J. E. CODMAN presented a Diagram for the "Regulation of Dimensions, etc., of Cast-iron Flange Pipes," the object being to establish, upon the basis of mathematical proportions, the diameters of flanges and bolt circles, sives and numbers of bolts and thicknesses of metal, for different diameters of pipes. Mr. EDWARD HURST BROWN described a test he had wittnessed of Fire Resisting Paint.

Mr. F. MEADE BACHE exhibited a Safety Self-Extinguishing Car Stove.

BOOK REVIEWS.

The Economic Theory of the Location of Railways, an Analysis of the Conditions Controlling the Laying Out of Railways to Effect the Most Judicious Expenditure of Capital. By ARTHUR MELLEN WELLINGTON, M. Am. Soc. C. E., Late Prin. Asst. Engr. for Location and Surveys, Mexican National Ry., Asst. Gen. Man. in charge of Location, Mexican Central Ry., and Chief Engineer for the American line from Vera Cruz to the City of Mexico. Revised and Enlarged Edition, New York; John Wiley & Sons, ENGINEERING NEWS. London, E. & F. N. Spon.; pp. 980 and xx; 314 engravings and plates; 205 tables.

It would be inappropriate that this journal should enter into any discussion of the merits and demerits of this volume, which is a revised and very much enlarged edition of the work under nearly the same title which was published by the author ten years ago, and shortly after went out of print. The book is divided into five parts, aggregating 33 chapters, under the following heads: Part I, Economic Premises. II. The Minor Details of Alignment. III. Limiting Gradients and Curvature. IV. Larger Economic Problems. V. The Conduct of Location. Nearly half the book is occupied by the tables and plates, and it is preceded by a four-page "Index to the More Important Rules, Tables, Formulæ and Final Conclusions which may be needed for Immediate Application, and followed by a general index of 27 pages of fine type, three columns to the page. Instead of the usual notice we reprint the substance of the preface:

"Only in a very figurative sense can this book be said to be a 'revised edition' of the little volume under the same title which the writer published ten years ago. The substance of the old book remains unchanged, so far as it went, but every page and sentence has been rewritten, except the dedication. The most important change in the nature of an addition is the much greater attention given to traffic and revenue questions, which are particularly likely to be underrated or forgotten. The mechanics of curve resistance have been discussed, it is hoped, more adequately than heretofore, and on a more solid basis of experimental fact, with some important practical questions which depend thereon. The theory of the effect of variations in velocity on the motion of trains is an entirely new addition, supplying one of the most important omissions of the former editions and of other engineering textbooks. The theory of various details of the locomotive, which did not seem to have been elsewhere adequately discussed for the purposes of this volume, has been given, it is hoped, more fully and correctly than heretofore. Parts IV and V are entirely new.

"On the other hand, the new edition has been abbreviated by omitting the discussions, some thirty in all, where reasons why the writer felt compelled to differ from some previously published conclusions or estimates were given in detail. This seemed necessary ten years ago, but at present it appeared as if the space might be better used.

"The number of engravings has been increased from half a dozen to 314, the number of pages from 216 to 980, and the number of tables from 44 to 205. All of the tables, with a few exceptions noted in connection with each, are original computations of the writer or compilations from original sources of information. As practically all the work of preparing them, and of rewriting the text, has been done outside of those hours which are ordinarily and more rationally regarded as working hours, a long delay in republication has been unavoidable; but if there be truth enough in the old antithesis of 'easy writing' and 'curst hard reading to hold good when twisted wrong end to, there should be some compensation in store for any reader who may have chanced to be annoyed by the delay.

"In order to adapt the volume to the more convenient use of all classes of readers, three sizes of type have been used.

"Long Primer type is used for those parts of the volume which were deemed most likely to be such as every interested reader would wish to read, including those who desire only to ascertain the more important conclusions, free from technicalities.

"Bourgeois type is used for discussions which relate more to the details of the subject than to principles, and hence may be passed over by those who are not engineers, or who are ready to take the reasons for what is printed in larger type for granted. Nevertheless, much of the matter which is printed in this smaller type, as for instance the long chapter on the locomotive engine, and the whole of Part V., is among the most important in the book for the professional engineer.

"Brevier type is used for minor notes and comments which it seemed essential or desirable to give, as of much possible importance to those wishing to look into the subject, or some particular branch thereof, with still greater care, but which might otherwise be passed over.

"The mathematical form of discussion has been intentionally avoided, first, because the book has been written for practical men as well as for students, and mathematical methods are apt to repel them; and secondly, and chiefly, because mathematical methods of solution are not only inexpedient, but positively dangerous for the class of problems considered. When the difficulty of a problem lies only in finding out what follows from certain fixed premises, mathematical methods furnish invaluable wings for flying over intermediate obstructions; but whenever the chief difficulty of a problem lies in the multiplicity and dubiousness of the premises themselves, and in reconciling them with each other, there is no safe course but to remain continuously on the sold ground of concrete fact. The invidious but simple fact of proving this by instances the writer will not attempt.

"To fully set forth in any one volume these premises for the correct laying out of railways, which include almost everything connected with their construction, operation, and finances, and vary in each case, would be impossible. The purpose in view has been merely to give between the covers of one book whatever was necessary for some approach to a correct solution of

every probable problem, which could not be found in other publications. This necessarily led to a large book, since this work still remains the only one on its subject in the language. Several of a somewhat similar nature have appeared in French and German since the first edition of this work was published, but from difference of operating conditions, and their profuse use of mathematics, the resemblance is not close."

PUBLICATIONS RECEIVED.

Seventh Annual Report of the Railroad Commissioners of Kentucky for the year 1886. pp. 186.

The Commission seem to be an active one. Among other interesting matter the following statement appears on the eighth page:

"It is very difficult to ascertain the cost of roads in this State. *There are only a few roads in the State that have not been sold at decretal sale.* Roads sold at decretal sale were reorganized by the purchasers, and the cost of those roads is what they sold for, not what was originally paid for their construction and equipment. There are six roads in the State that were never sold, and their cost, as shown in their annual reports, represents the price of the construction, equipment, terminal facilities, machine shops, offices, and other property acquired by the companies. The following table shows the cost per mile of the roads mentioned:

Louisville and Nashville—Main Stem	$38,649 09
Knoxville Branch	38,990.06
Glasgow Road	19 047 06
Shelby Railroad	13,089.01
Elkton and Guthrie	6,666.66
Ohio Valley	9,000.00

"The last named roads have been recently constructed, and their cheapness is *very* encouraging to new railroad enterprises in the State."

This list includes 422 out of the 1950 miles in the State.

TRADE NOTES.

WALPOLE ANILINE DYES.—The Walpole Dye & Chemical Works, of Boston, Mass., call renewed attention to their new method of putting up their aniline dyes in screw-cap bottles, containing about one ounce of color, properly labelled and with full directions for use. This style of package meets a long-felt want that is being much appreciated. One or two dozen bottles of assorted colors are put up to suit the wants of purchasers.

The Brick Industry About New York City.*

BY CALVIN TOMKINS.

The brick which came to this country previous to the present century were imported from Holland and England as ballast, and were used in the better class of structures only. These old brick were of fair quality, and as a rule, they are still in a good state of preservation in the buildings which remain standing. Brick were made along the Hudson and New Jersey shores previous to 1815. About this time, JAMES WOOD was making brick at Sing Sing; he soon after started a yard at Haverstraw, and in 1826, he began to mix coal dust with the clay before moulding. By the adoption of this process, he reduced the time necessary to burn a kiln of brick from a period of two weeks, to one week, and the cost of wood was reduced to two-fifths of the former cost.

Other manufacturers adopted his methods and began to realize a fair profit from the business. Prices fell off while the quality of the bricks improved and a growing demand stimulated the rapid growth of the industry. The process of moulding by hand was discarded about the year 1849, when VER VALEN, of Haverstraw, introduced the first steam moulding machine. With the exception of these two inventions, the methods of brick-making have remained practically unchanged in this vicinity.

Brick which come to the New York market are classed as follows, according to locality, viz.:

Haverstraws,—which include all brick made on the Hudson below the highlands.

Up Rivers—made on the Hudson above the highlands.

Jerseys—manufactured along the northwest coast of New Jersey.

Hackensacks — manufactured on the Hackensack river, New Jersey.

Long Island's—manufactured along the north shore of Long Island.

Staten Island's—manufactured along the Fresh Kills of Staten Island.

Front brick are brought here from Philadelphia, Trenton and Baltimore, and a second quality is made on the Hudson at Uplands and Croton. Fire brick and hollow brick are made in the district about Woodbridge, N. J., and on Staten Island. Buff colored brick are made of clays from Amboy and Sayerville, N. J., and at Glens Falls, N. Y.

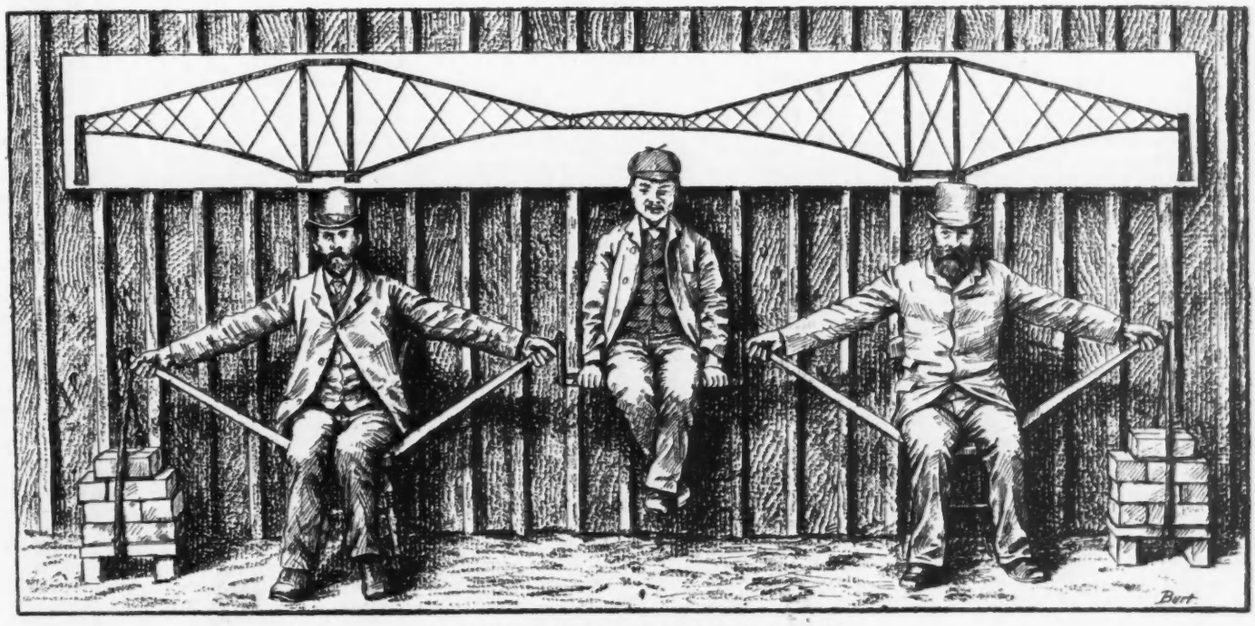
The clay about New York is generally overlaid with sand of good quality. The Long Island clays are variegated in color, and the brick made from them are of good quality. Few, however, come to the city market. The north shore of Long Island from Glen Cove to Greenport is girt with meadows and headlands of drift. These deposits of clay and sand are worked near Locust Valley, Cold Spring, Huntington, Greenlawn and Northport.

Few bricks are made at Staten Island, and these are of inferior quality, gray in color and brittle. They are only shipped to New York City during the winter season when ice obstructs Hudson river shipments. Jersey brick are known as *Dark-hards*, which have been highly burnt, are very dense, and of a dark red color. *Light-hards*, which are not so well burnt, of a lighter shade but which are hard and durable. *Grays*, which are under-burnt or made of clay not sufficiently rich in ferruginous matter to afford a proper color. *Sulphur brick* which are made from clay containing an excess of pyrites and which are more or less swelled, warped or spotted by the oxidation of this compound during ignition. Sulphate of iron is present in most of the Jersey clays and it appears in the brick made from them. Unless it is completely oxidized in the kilns, the process of oxidation is likely to continue in the presence of the air thus impairing the strength of the bricks. Near Keyport, N. J., a light red brick is being made by an improved process which gives promise of excellent results. A number of large yards put out bricks at Hackensack which are of a good uniform dark red color. They are liked by the city building trade on account of their fine appearance, but they are liable to be brittle. The facilities for manufacture at this point are soon to be greatly increased.

Brick are made along the Upper Hudson valley from Albany down to Haverstraw. As a general rule, it may be stated that the farther we proceed down the river, the better we find the quality of the brick to be till we arrive at Haverstraw, where the best common brick are made. Greenbush and Albany brick are roughly made and brittle. Those made at Covemans and Castleton are somewhat better in quality. Athens, Hudson and Cooksacie brick are of a gray, red color, not well made nor very strong, the Hudson brick being more inclined to a yellow red color. Glasco brick are stronger but gray in color. Catskill probably sends the strongest brick to the New York market. They are in good demand for constructive purposes although roughly made and of a light color. Good sand is scarce at Catskill, as it is at many other up river yards, and it is due to the lack of this material that the shrinkage and striped appearance of many of the Catskill bricks is due. Saugertis, Port Ewen and Kingston brick are well made and of good shape. This is especially true of the Kingston brick. Most of these clays, however, contain an excess of quicksand and the resulting brick are tender. They are also gray, with the exception of the Port Ewen brick.

The yards along Newburgh bay put out the best up river brick and for the last few years they have approximated both in price and quality to the Haverstraws. The Haverstraw influence has made itself felt here more than elsewhere and many of the yards are operated by men who have come up from Haverstraw bay,

*Abstract of a paper read before the American Society of Civil Engineers, and revised by the author for the "Clay-Worker."



A Japanese Illustration of the Cantilever Principle.

A Novel Illustration of the Cantilever Principle.

The ingenious illustration of the cantilever bridge principle which we illustrate needs little explanation to engineers, since it explains itself. It was a Japanese idea, as may be suspected from the central figure, and the photograph from which we take our engraving was recently used by Mr. BENJAMIN BAKER in a lecture on the Forth bridge before the Royal Institution where it was received with loud and general applause.

It will be seen that the device consists merely of a "brick anchorage," four loose sticks as "compression members," which are simply butted against the wooden chairs and grasped by the "tension members" at each end, and the loosely hung "central span" on which the young Japanese sits. It is stated also, with strong probability, that when some one accidently stumbled against the "anchorage" this latter gentleman had an ignominious tumble.

The photograph contains a hint which our technical schools may profit by, since it brings out the principle of the cantilever in a way that no one can fail to grasp. We are indebted to Mr. THOS. C. CLARKE for the use the of original photograph.

In discussing the quality of brick as related to locality, as stated must be received in a general sense, as local advantages or disadvantages are treated in very different ways by the manufacturer. Good brick are often made by a careful man out of bad material, while the reverse proposition is equally true. The demand for the best brick is not great. The speculative building interest will use what the law allows if it cannot do better on the sly, and all pale brick is supposed to go to Brooklyn where the law is more considerate.

The brick made along the Haverstraw bay bring better prices and are of superior quality to those made elsewhere. This is due principally to two causes: 1. The tempering sand in this section is abundant and of the best quality. The clay is also claimed to be of superior quality. 2. The experience of brickmaker's counts for more as the industry has been of longer standing. Generally speaking, the brick possesses a finer finish and are more regular in form than those made at other points, and they are stronger than other bricks.

Deposits of clay in this section when adjacent to the river possess a high value. Banks can seldom be bought, as the owners prefer to work them on the royalty system which prevails. The bank owners are in most instances retired brickmakers. The plant, consisting in most instances, of machinery, house, sheds, etc., goes with the right to use clay and sand and the lessee agrees to pay so much per M brick made, binding himself to make a specified quantity or more each year. Royalties along Haverstraw bay range from $.50 to $1.50 per M brick made, the difference being accounted for in comparative natural advantages of the yard, such as length of haul, quality of plant, etc. Up river yards, with the exception of some along Newburgh bay, command lower rents. Long Island, Jersey and many of the up river yards are worked at first hands, the margin not yet being sufficient to admit of two profits.

A thin layer of yellow clay overlies the blue clay about Haverstraw and mixed with the latter gives color to the brick. The method of manufacture may be briefly described as follows: After stripping the sand the stiff clay is cut out in benches and carted to the yards. In some instances the mud is tempered by a vertical wheel revolving in a circular pit 2½ ft. deep by 30 ft. in diameter. In most cases, however, the sand, clay and coal dust are spread in alternate layers in a sod pit 16 ft. by 12 ft. by 4 ft. A bushel of coal dust being allowed to each thousand of brick. The pits are filled in the afternoon and the material shoveled directly from them into the hopper of the brick machine which pugs it and presses it into the moulds. The moulds are trucked to the drying yard, dumped there; the green brick turned on their edges after a few hour's exposure, spatted, and later hacked up, where they remain under battens for several days till they attain sufficient strength to bear their weight in the kilns. The kilns are of the usual type, known as clamps. In a few instances they have stationary walls, but, as a rule, they are entirely constructed of the brick to be burnt. After being daubed with mud on the sides and cushioned with sand held in place by battens at the ends, they are fired with wood under the arches. Coal on grate bars is used in New Jersey under the arches. The kilns are built under sheds and run along the river front in most instances. The brick are loaded on the boats by barrows. 300,000 to 1,000,000 brick are burned in a kiln, allowing 35,000 to 40,000 to an arch. The kilns are built with a slight batten, 50 brick high on edge and 36 ft. wide at the base. The bricks are set crossing each other, three on three, with vents ¼ in. to ⅜ in. between.

Barometric changes, changes of temperature and of the wind have to be taken into consideration by the burner. As a matter of course, bad burns occasionally are met with. The arch brick are always overburnt and the outside brick under-burnt. This constant loss in conjunction with the loss of green brick damaged by weather is a serious drain on the industry and also tends to deteriorate the quality as it is the general custom to work off the greater part of these poor brick by inserting them among the good brick. Brick-makers have estimated that by the present process, a twelfth of the kiln turned out pale brick and a twentieth, arch brick.

One man to each thousand brick made per day, is the labor estimate usually allowed.

Brick are designated according to quality, as: *Goodhards*, which includes all well made and well burnt brick; *Pales*, which are under-burnt; *Arches*, which are over-burnt, usually at the ends; *Swelled brick*, sometimes called *lammies; Spotted brick*, more or less mottled in appearance; *Whitewashed brick*, in which the alkali have effloresced in the kiln (due principally to an excess of water); *Brittle brick*, which become broken brick; *Washed brick*, which have been pitted by rain when green.

The regulation size for common brick as far as such standards exists, is 8 x 3½ x 2¼ inches. In the trade parlance, 5 adjacent brick on edge should run 11½ in. through.

Much criticism has been directed against the brick industry of this section for its lack of enterprise in taking hold of improved methods. Doubtless much of this criticism is well founded, for certainly very few changes have been made, while in the west and south, many improvements have been introduced, such as appliances for grinding the clay and puddling the mud, tunnel and oven dryers in which the brick are dried quickly and without risk of exposure to the weather. Bricks are burnt in permanent kilns and in continuous kilns, by the use of which a great saving of heat is accomplished; coal takes the place of cord wood and it is claimed that gas has also been successfully used. To all this, brick men reply that these improvements may be well enough adapted to yards in other localities, but about New York, where it is necessary to crowd a year's work in six months, they have not the requisite time or yard room to manufacture by any other method than that now in use. Probably a further explanation of this apparent inertia is to be found in the fact that most of the older established yards and those most profitable along Haverstraw and Newburgh bays are owned by one set of men and worked by another set.

The following are the prices reported by *The Record and Guide*" for cargo lots on dock at New York City. Quotations taken first week in July for the year 1873 to 1886, inclusive:

	Jerseys.	Up Rivers.	Haverstraws.
1873.	$6 to $6½	$6½ to 7½	$7 to $8½
1874.	5½ " 6	5½ " 6½	6 " 8
1875.	5 " 5¼	5 " 5½	5¾ " 6½
1876.	.....	4 " 4¾	4½ " 5½
1877.	.....	3¾ " 4¼	4½ " 6
1878.	.....	3½ " 4	4 " 5
1879.	4½ " 5	5 " 5¼	5½ " 6
1880.	.....	4½ " 5	5 " 6½
1881.	.....	7½ " 7½	7½ " 8
1882.	6 " 6¼	6¼ " 6¾	6¾ " 7¾
1883.	6¼	6¼ " 6¼	6¾ " 7
1884.	4¾ " 5½	5¼ " 6	6 " 6½
1885.	5½ " 6	6½ " 6½	6½ " 7
1886.	5½ " 6	6¼ " 6½	6¾ " 7¾

The above table goes to show that when brick realize much less than $4.50 per M., it is not profitable to send them to market.

CONSTRUCTION NEWS.

Water.

WE will be obliged if every water-works superintendent or engineer, or other official in charge of the distribution of their official printed reports, will see that this office is furnished with a copy of each report issued since 1884, and also give us rates at which water is sold by them. We will be careful to acknowledge receipt of such reports and wherever there are any novel features of importance to the general public, we will be sure to note them in the columns of this journal. Early information also about elections of officers; about extensions of works; the purchase of new machinery and other news of direct interest to parties engaged in the construction and management of water-works is specially solicited. Be careful to address all correspondence to Tribune Building, New York City.

Boston, Mass.—The bill to authorize the city to draw a supply from the Shawsheen river has been thrown out by the Senate.

The Panama Water Supply & Improvement Co has been incorporated by CONRAD N. JORDAN, HERMAN KOBBE, JOSE M. HURTADO, EDWARDS GOGORGA and VINCENTE N. HURTADO. Capital stock, $100,000.

The Sewage Polluted Passaic.—Citizens interested in a better water supply for Jersey City have issued a pamphlet that tells the whole story of the present polluted supply in the map presented with it. This map is in colors, and shows the Passaic river from Paterson to its mouth in Newark bay, and also shows the relation of the Belleville intake of the Jersey City water-works with reference to the sewage inlets of the cities, towns and factories on the Passaic and its branches. It is a lamentable exhibit, and a frightful one in its possibilities not only to the Jersey City water consumers, but to all others that now take their water from the same source. The map in itself is enough and hardly needs the analysis of Prof. LEEDS and the condemnatory reports of the many engineers and experts which accompany it, and back up its graphic exhibit.

Toledo, O.—The City Civil Engineer has issued his report for 1886. The city work during the year has included 56,475 sq. yds. of paving, 5,380 lin. ft. of macadamizing, 8,477 cu. yds. of grading, 14,956 lin. ft. of planking, 10,503 ft. of sewers, and 15 miles of new sidewalk (7.3 miles of stone and 7.7 miles of plank and brick.) Sheet asphalt on concrete foundation has been laid on Collingwood street. The sewer work comprises 16.5 ft. of 5 ft. diameter, 3,199.8 ft. of 3 ft., 6,863.8 ft. of 2 ft. and 422.9 ft. of 20-in.; the aggregate cost was $23,673.06. Full descriptions of the location of all improvements are given, and tables of the location, material, etc., of paving and sewer work.

Butler, Mo.—The time for letting the water-works contract has been extended to June 15. It is proposed to grant a franchise for a number of years, and to let the entire work to some responsible party. Address G. B. HICKMAN, Mayor.

Springfield, O.—The suit brought by manufacturers against the Water Works Trustees has been decided in favor of the plaintiffs. The defendants are permanently enjoined from drawing water from Buck or Beaver creek, or Spring branch, through the water-works, so as to reduce the ordinary water level of Buck creek at Plaintiff's dam, and in no event are defendants to draw in connection with the water-works, more than 500,000 galls. per day.

Chester, Pa.—Samuel R. Bullock & Co., of New York, contractors for the works of the new Chester Water Co., are at work on the reservoirs, which will have a capacity of 12,000,000 galls.; some of the mains are also being laid. The water will be taken from the Delaware river through a 30-in. suction main to the two horizontal pumping engines, which will have a daily capacity of 4,000,000 galls each, and forced through a 20-in. main to the reservoirs. E. F. FULLER is Chief Engineer for the contractors; GEORGE T. KEITH is Engineer in Charge, with C. E. DICKINSON as Assistant Engineer.

The El Dorado Water & Deep Gravel Mining Co. proposes to bring a canal into Sacramento county, Cal., 30 ft. wide and 6 ft. deep, of sufficient capacity to irrigate all the land between the American and Cosumnes rivers, a territory of 200,000 acres. The head of the canal will be at the mouth of Weber creek, three miles above the Salmon falls, on the South fork of the American river. The company has immense storage lakes in the Sierras, in El Dorado county, to draw on in the dry season, and can keep the canal full throughout the year. The largest reservoirs are Silver and Echo lakes, which contain an unlimited supply of pure clear water. This canal will be 30 miles long, and besides irrigating the lands will furnish power for manufactories in Sacramento.

Peter burg, Ill.—W. R. COATS, hydraulic and sanitary engineer, of Kalamazoo, Mich., has made a report on a system of water supply. Mr. COATS made a report ten years ago, but his recommendations were not carried out, and he now urges that prompt measure be taken, stating that had the improvements been carried out ten years ago the cost would by this time have been returned ten fold. The proposed works, of which plans and specifications have been submitted, are for a pumping and reservoir service, comprising supply well pumping works, reservoir, 5 miles of mains, from 4 to 16 ins. diameter, 65 double fire hydrants and all necessary stop valves. The cost for the complete system is estimated at $40,000, or $32,000 for a supply to the chief business part of the city; if the reservoir is omitted the cost would be $23,500 and $17,500 respectively, but this is not recommended as it would impair the efficiency of the works and increase the operating expenses $1,000 per year. A further reduction of $2,000 might be made by taking the supply direct from the river, but this would be unsatisfactory for domestic purposes, and the supply well, furnishing pure water from the sand and gravel of the river valley, is recommended. The population is about 10,000.

Hannibal, Mo.—J. H. DECKER, Superintendent of the Hannibal Water Works, sends us a pamphlet containing the rules and regulations, a schedule of rates and a description of the works. Work was commenced in the fall of 1879, and pumping was commenced Feb. 1, 1880. The reservoir which was completed in July, 1880, has a capacity of 1,500,000 galls. and is 235 ft. above the city datum. The original pumping plant was a Blake duplex engine with a daily capacity of 1,500,000 galls., and in 1885 a vertical, compound, condensing engine, built by E. P. Allis & Co., of Milwaukee, Wis., with a daily capacity of 2,500,000 galls. was put in. The distribution system comprises 14 miles of cast-iron mains, from 4 to 14 ins. diameter, 82 fire hydrants, 83 gates and 750 service taps. The supply is drawn from the Mississippi river and passes through a series of screens and a filter well (containing sponge, granulated coke, gravel and sand) to the pump well. The water, though sometimes "roily," is said to be quite wholesome. The works are owned by the Hannibal Water Co.; President, Jos. G. CHAPMAN; Vice President, CHARLES PARSONS; Secretary and Treasurer, HORATIO D. WOOD.

Cornwall, Ont.—The works, which have been constructed by Moffett, Hodgkins & Clarke, of Watertown, N. Y., are completed and were tested May 3: W. CHIPMAN, C. E., of Brockville, acting as expert for the corporation. The works have been accepted. The supply is drawn from the St. Lawrence river and pumped to a stand-pipe, or direct pressure can be applied when necessary. The two compound, duplex, condensing, Worthington pumps have a daily capacity of 1,000,000 galls. and they draw the water through a 16-in. main and force it through a 12-in. main to the stand-pipe, which is 20 ft. diameter, 120 ft. high, has a capacity of 300,000 galls. and was built by the Sharon Iron Works, Sharon, Pa. There are two boilers built

by Inglis & Hunter, of Toronto. From the stand-pipe a 2-in. main leads to the distributing system, which comprises 8 miles of 8, 6 and 4-in. pipe. There are 57 hydrants, supplied by Chas. Smith & Co., of Toronto, and 28 valves, supplied by the Ludlow Valve Co., Troy, N. Y. The pipe was furnished by Alex. Gartshore, Hamilton, Ont. The works are designed for a population of 25,000, and work upon them was commenced last summer. WILLIS CHIPMAN has acted as engineer for the town, O. W. WEED was Superintendent of Construction, and JAMES STRICKLAND, of Cohoes, N. Y., will be General Manager.

Nebraska City, Neb.—Work is progressing on the new water-works, and they will be in operation by July. The reservoir has a capacity of 700,000 galls. There will be two direct acting, horizontal, compound pumping engines with a daily capacity of 1,000,000 galls. each. Two filtering plants will be put in, each with a daily capacity of 144,000 galls. The stand-pipe is of steel plates, and is 12½ ft. diameter by 100 ft. high. The pipe system, exclusive of hydrant connections, will comprise 3,000 ft. of 12-in. pipe, 1,575 ft. of 10 in., 4,350 ft. of 8-in., 13,875 ft. of 6-in., and 8,880 ft. of 4-in., a total of 6 miles of mains. The works are designed for a population of 25,000. The City Water-Works Co. was incorporated in February, 1887, by D. P. ROLFE and H. N. SHEWELL, of Nebraska City; JOHN M. WALKER, of Lawrence, Kan., and ALEXANDER G. BLACK and ROWLAND R. HAZARD, of New York. Capital stock, $200,000.

Sault Ste. Marie Water Power.—Capitalists of La Crosse and Milwaukee are interesting themselves in the water power at Sault Ste. Marie, although as far back as 1850 SAMUEL WHITNEY proposed its utilization on a colossal scale. The present company has spent $100,000 in securing a strip of land about 2 miles long and not less than 150 ft. wide, mainly in the village. The company includes J. G. STRADLEY and JAMES F. BASSETT, of Iowa; S. D. CARGILL, J. B. CANTERBURY and others of La Crosse, Mich., ROBERT ELLIOTT, of Milwaukee and other grain and elevator men of the Northwest. They promise the greatest piece of hydraulic engineering this country has ever seen.

Brooklyn Water Department for 1886.—Chief Engineer ROBERT VAN BUREN, of the Department of City Works, of Brooklyn, has issued his annual report for 1886. The average daily consumption of water was over 45,000,000 galls., an increase of about 2,000,000 galls. over 1885. The Chief Engineer again points out the necessity for the extension of the works on a large and permanent basis, and points out the fact that while the narrow and costly policy of adding to the supply by procuring water from within the lines of the present works by driving wells, etc., has periodically prevented a water famine, it has nearly exhausted the water resources of that region and will not do for the future. Plans for the new works have been prepared since 1884, and the necessary land and water rights were purchased in 1885, but nothing has been done in the way of construction. During the months of maximum consumption last year there was only four days consumption in reserve. The report contains a summary of the condition of the Brooklyn water supply from 1856 to the present date, with the additions of each year. The driven-wells put down by Messrs. Andrews & Co. have furnished an average of 20,000,000 galls. daily in times of extreme draught.

IN the compilation of Statistical Tables of American Water Works, special efforts were made to have them as accurate as possible. Errors have occurred in a few instances which have been brought to our attention, and we especially solicit early information of *any errors* that *any person* may discover, so that they may be corrected. The range of information in future editions will be greatly extended, and we now invite suggestions upon the features most desirable, from water-works officials, engineers, contractors, and parties dealing in machinery and other supplies for water-works. ALL CORRESPONDENCE, ALSO ALL REPORTS, MUST BE ADDRESSED TO ENGINEERING NEWS, TRIBUNE BUILDING, NEW YORK, as future issues will be compiled in this office and under our personal supervision.

New Water-Works.—Waterville Me. Work has been commenced. Engineer, H. G. DENNIS, New Bedford, Mass; contractor. Jas. J. Newman, Providence, R. I. —Boothbay, Me. Works will be constructed by the Gardiner Water Co.—Thomaston, Me. A supply will be furnished by the Camden & Rockland Water Co.—Portland, Me, The Portland Water Co. will build a reservoir on Munjoy hill; it will have a capacity of 20,000,000 galls., the one on Bramhall hill has a capacity of only 10,000,000 galls.—Ware, Mass. The works are to be extended.—East Albany, N. Y. Work has been commenced at the site of the water tower; it will be 25 ft. diameter and 80 ft. high. O. W. WEED, is Superintendent.—Montclair, N. J. The mains are being laid.—Chester, Pa. The South Ward Works, recently leased by the city, have been sold to the new Chester Water Co.—Merchantville, N. J. The works have been completed. The water is pumped from a reservoir, supplied by springs, to a stand-pipe, 8 ft. by 100 ft.; there are 28,000 ft. of pipe and 20 hydrants. ISAAC S. CASSIN and HOWARD MURPHY, of Philadelphia, were the engineers.—Mechanicstown, Md. Proposals will be advertised for shortly; the supply will be drawn from a mountain stream.—Salem, O. Turner, Clark & Rawson are building the works; there will be 15 miles of mains and 165 hydrants: the contract is for an annual rental of $4,000 for 30 years.—Bismarck, Dak. There will be two reservoirs with a capacity of 2,000,0 0 galls. each, and a pumping engine with a daily capacity of 500,000 galls. There will be 4½ miles of pipe and 40 hydrants, for an annual rental of $4,000.—Council Grove, Kan. Inman Bros., of New York, will have the works in operation by August.—Clyde, Kan. Artesian water has been struck.—Fort Smith, Ark. A new Worthington pump, with a daily capacity of 4,000,000 galls., has been put in, giving an aggregate supply of 6,000,000 galls. The improvements were carried out by A. L. Pogue, of Richmond, Ind., and cost $100,000, making a total cost of $230,000.—Berthoud, Col. Work has been commenced; the system will cost $12,000.—Weeping Water, Neb. No bids have been received yet, and the town is waiting for propositions for a franchise.—Cedartown, Ga.—Nashville, Tenn.—Jonesboro, Tenn. —Bessemer, Ala.—Titusville, Fla.—Lewiston, Ill. —Beaver Dam, Wis.—Rhinelander, Wis.

WE have mailed a free copy of Statistical Tables of American Water Works of 1887 to every water-works company, public or private, listed in the Tables: to make sure of their having been received, we notify all those sent to by postal card of our action in the matter, and in a number of cases we have duplicated the sending on account of the first book having been lost in the mails. *If there is a single water-works office in the United States or Canada* where at least one copy of our Statistical Tables cannot be found, we will be obliged for the information. We have also distributed 500 copies among the newspapers of the country and have had nearly as many notices. In a number of cases we have supplied a city council with one or more copies by request, and it may be assumed that the edition has been very thoroughly distributed "where it will do the most good."

Proposals Open.

Reservoir.—For the new water-works. LONG & DOUBLEDAY, Columbus, Kan.

Water-Works.—Bonds for $24,000 voted. THE MAYOR, Falls City, Neb.

Granite.—James river granite. W. E. CUTSHAW, City Engineer, Richmond, Va. June 13.

Water-Works.—Time extended. ISRAEL D. BOWMAN, Berlin, Ont. June 13.

Street Work.—Earth and rock excavation, filling, paving, flagging, curbing, bridge stone, cribbing, basins, etc. PEARL C. HILLIARD, Chairman of the Committee on Streets and Sewers, Board of Public Works, Jersey City, N. J. June 13.

Dredging.—In Toronto harbor; 10,000 cu. yds. in the slips and the Don channel; 30,000 cu. yds. in Western channel. MORGAN BALDWIN, Harbor Master, Toronto, Canada. June 13.

Sea Wall and Bulkhead.—WM. S. BARBOUR, City Engineer. E. W. HINCKS, Chairman of Committee on Roads and Bridges, Cambridge, Mass. June 13.

Sewers.—Vitrified pipe, 8-in. diameter, and all appurtenances. W. J. FLANIGAN, City Clerk, Binghamton, N. Y. June 14.

Bricks and Iron Work.—Supplies for year ending June 30, 1888. WM. CARLYLE, Chairman, Committee on Works, Toronto, Canada. June 14.

Steam Heating Apparatus.—G. MUN, Clerk of Board of Education, Suspension Bridge, N. Y. June 14.

Water-Works.—Franchise to be granted for a number of years, G. B. HICKMAN, Mayor, Butler, Mo. June 15.

Pipe, Hydrants and Valves.—Cast iron pipe, 2,700 ft. of 8-in., 300 ft. of 4-in., 1 T special, 8 to 4-in., 1 8-in. Y., 1 8-in. stop valve, 2 4-in. hydrants. Also for laying pipe and moving the pumping plant. H. E. HEDEMAN, City Engineer. J. W. TOWNSEN, Chairman, Water Board, Lampasas, Tex. June 15.

Jail.—Architect, N. J. GIBBS, Mt. Clemens, Mich. N. T. KIRK, Secretary of Committee, Howell, Mich. June 16.

Pile Bridges.—Across Tolt river. LYMAN WOOD, County Auditor, Seattle, Wash. Ter. June 16.

Water-Works.—To cost about $13,000; bids for a complete system on the rental plan. A. A. RICHARDSON, Lincoln, Neb., Chief Engineer. THE MAYOR, Ashland Neb. June 16.

Pier and Bulkhead.—New wooden pier and crib bulkhead at W. 132nd street and repairing crib bulkhead at W 131st street (North river); also crib bulkhead, etc., at E 76th street (East river). THE DOCK COMMISSIONERS, Department of Docks, Pier A, North river, New York City. June 16.

Granite Paving.—GEORGE RICARD CONNER, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. June 16.

Dredge, Etc.—Furnishing 1 dredge, 1 tug and 2 dump scows for St. Mary's river. Lieut. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. June 17.

Railroad.—Construction and equipment of the Red River Valley R. R., from Winnipeg, Man., to West Lynn, opposite Pembina, Dak., 75 miles. Work to be completed by November. Hon. JOHN NORQUAY, Premier of Manitoba, Winnipeg, Man. June 17.

Water Pipe and Specials.—Cast-iron pipe; 27 tons of 4-in., 121 tons of 6-in., 30 tons of 8-in., and 22 tons of 10-in.; 10,000 pounds of special castings. THOS. J. NEVILLE, Clerk of Executive Board, Rochester, N. Y. June 17.

Bridge.—Wrought-iron bridge over the Genesee river. K. A. HUGHSON, Chairman, Bridge Committee, care of County Treasurer, Rochester, N. Y. June 18.

Gas Lamps and Pillars.—F. W. KING, General Superintendent of Lamps, Baltimore, Md. June 20.

Street Work.—Curbing and sidewalks. FRED. J. H. RICKON, City Engineer. THE BOARD OF COMMISSIONERS, Little Rock, Ark. June 20.

Sewers and Drains.—THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. June 20, 21.

Pier.—At W. 31st street. THE DOCK COMMISSIONERS, Department of Docks, Pier A., North river, New York City. June 21.

Brick Pavement and Paving Brick.—Vitrified fire clay brick pavement, 13,000 sq. yds.; also for furnishing the city with brick. J. M. RENO, City Engineer, Youngstown, O. June 22.

Submarine Pipe.—Furnishing and laying 700 ft. of submarine 20-in. iron pipe; and building timber inlet crib. P. H. BAKEMAN, Troy, N. Y., Engineer. THE WATER COMMISSIONERS, Schenectady, N. Y. June 22.

Street Work.—Grading, curbing and asphalt pavement. R. R. MARBLE, City Engineer, Columbus, O. June 27.

Water-Works.—P. FRAM, President, Water Board, Yorkville, Ill. June 30.

Iron and Steel.—For gates and trestle, Great Kanawha river improvement; cast iron, 22,500 pounds; wrought-iron, 43,000 pounds; steel, 2 200 pounds. A. M. SCOTT, Resident Engineer. Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va. July 1.

Supplies.—Cement, broken stone and sand, nails, anchor bolts, timber, etc. THOS. H. LOOKER, Pay Director, U. S. N., U. S. Navy Pay Office, Washington, D. C. July 2.

Rock Excavation.—Removing rock bar in the Ohio river at the mouth of Licking river, 30,000 cu. yds.; amount available, $18,000. Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O. July 5.

Boilers.—Four steam boilers of 100 H. P. each; iron stack, 55 ins. diameter, 114 ft. high. H. M. JONES, Superintendent, Cincinnati Hospital, Cincinnati, O. July 6.

Contracting.

Canal Work.—Brown Bros., of Mohawk, N. Y., have been awarded the contract for excavation and masonry for the enlargement of the canal of the Cohoes Water Co., at Cohoes, N. Y. The contract price was $60,000.

Depot.—A union depot, which will be used by nine railroad companies, is to be erected at Memphis, Tenn. The ground has been purchased by C. P. HUNTINGTON.

The Cleveland Hydraulic Dredging Co. has been incorporated at Cleveland, O., by P. W. RICE, B. F. MORSE, and others. Capital stock, $25,000.

Dredging.—The following proposals for dredging in the Thames river, Conn., were opened June 6, by Lieut. Col. D. C. HOUSTON, Army Building, New York: Hartford Dredging Co., Hartford, Conn., 12 cts. per cu. yd., $4,800; Richard Parrott, Newburg, N. Y., 36 cts., $14,400.

Walk.—The following proposals for an elevated walk on the pier at Dunkirk harbor, N. Y., were opened June 4 by Maj. S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich.: Walter K. Williams, Dunkirk, N. Y., $1.14 per ft.; W. J. Harris, East Avon, N. Y., $1.18.

Iron Work.—The contract for the cast and wrought-iron work for the floors, roof and dome of the State Capitol, Topeka, Kan., has been awarded to P. E. Lane, of Chicago, at $69,868.—The Pittsburgh Traction Co., GEORGE W. ELKINS, of Philadelphia, President, has awarded contracts for iron work to Oliver Bros. & Philips and Riter & Conley.

Sewers.—The following proposals were opened June 7 at Torrington, Conn.: Clark & Byron, New York City, $7,840.50; James J. Cogan, Bergen Point, N. J., $9,534.40; Franklin A. Snow, Providence, R. I., $9,933.25; J. N. Austin, Bridgeport, Conn., $10,213.20; A. Brazos & Sons, Middlefield, Conn., $10,740.95 Matthew Kehoe, New Haven, Conn., $13,133; L. W. Burt, Hartford, Conn., $14,047. The contract was awarded to Clark & Byron.

Water-Works Pumps.—On our advertising pages will be found an advertisement for proposals for two steam pumps, with a daily capacity of 3,000,000 galls. each, for Allentown, Pa.

Laying Water Mains.—The following proposals were opened June 7, by the Water Commissioners, Schenectady, N. Y. M. Nolan, Schenectady, 4-in. mains on Terrace street, 20 cts. per ft.; 4 and 6-in., on Union street, 21¼ cts.; 4 and 8-in., on State street, 24 cts· Benjamin Van Vranken, Schenectady, 26 cts. per ft.

New Sewer Work.—At East Saginaw, Mich., plans for the following sewer work will be ready in a few weeks; 1,200 ft. of 12-in.pipe, 500 ft. of 18-in. pipe, 300 ft. of 20 x 30-in. egg shaped brick and 2,600 ft. of 56 x 84-in. egg shaped brick. Proposals for brick and pipe sewer were opened June 4; the bidders were John C. Davis, C. Brooks, O'Conner & Niger, Kelly & Lamson and J. P. & A. Davis. JOHN J. GRANVILLE, City Engineer.

Water-Works.—Turner, Clark & Rawson, of Boston, have the contract for the water-works at Old Orchard, Me.——Goodhue & Birnie, of Springfield, Mass., have the contract for extending the water-works at Concord, to Penacook, N. H., and other villages. The firm has completed works at Hillsboro, N. H., and will build a system at Barre Vt.——Lang, Goodhue & Co., Burlington, Vt., have the contract for water-works at Swanton, Vt.; the contract price is $15,000, and 27 hydrants are to be set.

Bridges.—John L. Means, of Grand Island, Neb., has the contract for a wagon bridge across the Loup river, at $10,000.——Paquet & Smith, Portland, Ore., have the contract for rebuilding a bridge.——The King Iron Bridge & Manufacturing Co., Cleveland, O., has the contract for an iron bridge across the Guadalupe river at Cuero, Tex.,——The Berlin Bridge Co., Berlin, Conn., has the contract for a bridge at Walden, N. Y., for $13,900.——Dean, Westbrook & Co., of New York, have the contract for two iron bridges across Schoharie creek at Schoharie, N. Y.; the contract price is $27,000.

Sewer Contracts.—D. F. Minahan, Springfield, O., has the contract for the Park street sewer at Dayton, O: it is to be 8 ft. diameter and 5,250 ft. long: the contract prices on the three sections are $16.41, $17.99 and $14.40 per ft.——At Utica, N. Y., a contract has been awarded to J. G. Sweeney at 78½ and 93 cts. per ft. for 12 and 15-in., sewer, and $55 each for manholes; also to J. J Dwyer at 73 cts. and $4.55 for 9 and 30-in. pipe, $3.25 each for branches; manholes, $55 each; catch basins, $65; lumber, 14; rubble masonry, $6 per cu. yd.; concrete, $5.75.—At Hartford, Conn., Sylvester and Bissell have the contract for a 42-in. sewer.——At Milwaukee, Wis., a contract for a brick sewer has been awarded to Thos. Morrissey, and for pipe sewers to D. O'Driscoll, Jacob Werner, Thos. Markey and Chas. Brand.—— At St. Paul, Minn., contracts have been awarded to E. J. Kirkland and P. Doherty.

Bridges.—The following proposals for iron bridges across Perkiomen creek and Swamp creek, respectively, were opened June 4 by the County Commissioners, Norristown, Pa.:

	Perkiomen. Price per ft.	*Swamp* Price per ft.
	$	$
Standard Bridge Co., ...	18·00	15·00
J. Denithorne & Son, Phœnixville, Pa··	19·78	17·83
Wrought-Iron Bridge Co., Canton, O····	21·70	17·20
Columbia Bridge Co., Dayton, O.....	22·10	18·90
Penn Bridge Co., Beaver Falls, Pa.....	22·35	7·60
Massillon Bridge Co., Massillon, O.....	22·50	18·50
Groton Bridge Co., Groton, N. Y.....	22·94	19·98
Mount Vernon Bridge Co., Mt. Vernon, O.	24·00	2·00
West Point Engine & Machine Co····	24·50	0·00
Pittsburg Bridge Co., Pittsburg, Pa.....	25·33	13·00
Dean & Westbrook, New York City.....	26 00	14·00
Morse Bridge Co., Youngstown, O., (complete)..	2,469 | 5,617 |	1 223 1.322
Berlin Iron Bridge Co., East Berlin, Conn	5,210	14 65

Contracts for masonry were awarded as follows: Perkiomen and Swamp creek bridges, Willoughby H. Smith, $1,777 and $1 444; Frog Hollow bridge, Hugh O'Neill, $4,915.

Street Work.—At Newark, N. J., the following contracts were awarded June 7: B. M. & J. F. Shanley, oblong granite block paving, $2.65 per sq. yd.; Belgian bridge stone, 40 cts. per sq. ft. Thomas O'Connor, cobblestone paving, 62 cts. per sq. yd.; bridge stone, 34 cts. per sq. ft.; also, cobblestone paving, 65 cts.; bridge stone, 34 cts.; oblong trap block gutter paving, $2.20. E. ADAM, City Surveyor.——At Toronto, Can., a contract has been awarded to Wm. Cathro, at 84 cts. per sq. yd., for paving, 19½ cts. per ft. for curbing, and $3 per 100 pounds for iron crossing plates: also to Robert Forsyth for granolithic sidewalk at $4 per ft.——At Pittsburg, Pa., the following contracts have been let; K. Bracken, paving, $1.38 per ft.; Joseph Hastings, grading, 24 cts. per yd.; Booth & Flinn, block paving, $2,99 and $3 per ft., Neuchatel asphalt paving, $4 per ft.; H. C. Gearing, white pine blocks, $25 per 1,000.——At Leavenworth, Kan., the following contracts have been let: paving with 7-in. cedar blocks on 6-in. concrete, J. B. Smith & Co., Chicago, $1.89 per sq. yd.; grading, Kansas & Nebraska Paving Co., Omaha, 27 cts. per cu. yd.; curbing, Geiger & Campbell, Leavenworth, 4 x 20-ins. and 5 x 24-ins., 59½ and 82 cts. per ft.——At Louisville, Ky., the contract for granite blocks has been awarded to Walter R. Davis at $0.25 per ton.——At Brooklyn, N. Y., the bids for flagging sidewalks were; Thomas R. McCann, 19½ cts. per sq. ft.; Charles S. Lynan, 20 cts., and Henry Mogk, 20¾ cts.——At St. Paul, Minn., contracts for street work have been awarded to Thornton & Shaw, Fulsom & Murray, Forrestal & Riley, and F. S. Blodgett.

Sewers.—The following proposals were opened June 3 by G. R. CONNER, Commissioner of City Works, Brooklyn, N. Y.: Edward Freel, 36 and 30 in. brick sewer, $3 10 and $2.60 per ft.; 18, 15 and 12 in. cement pipe, $1.65, $1.40 and 97 cts. per foot.; manholes, $33.75 each; street basins, $85 each.——Edward Gorman, $3.70 and $2.90; $1.55 $1.33 and 99cts.; $33, $99.——John S. Bogert, $4 and $3.40; $1.85, $1.65 and $1.10; $34, $98.——John J. Hart, $4.20 and $3.80; $1.73, $1.57 and $1.19; $34, $110.——Harris & Maguire, $4.70 and $3.60; $2.28, $2 08 and $1.71; $45: $110.

Dredging.—The following proposals were opened May 31 by Lieut. Col. O. M. POE, U. S. Engineer Office Detroit, Mich.: For dredging harbor at Cheboygan Mich.; Green Bay Dredge & Pile Driver Co., Green Bay, Wis., 11½ cts. per cu.yd., measured in the scow; Carkin, Stickney & Cram, East Saginaw, Mich., 14¾ cts.; Chas. B. Crane, Chicago, Ill., 15½ cts.; C. E. Mitchell, Ludington, Mich., 17⅞ cts.; A. H. Williams, Sault Ste. Marie, Mich., 18 cts.; Buck & Hubbell, Saginaw, Mich,, 19½ cts.; Williams, Upham & Co., Duluth, Minn., 23 cts.; Robert Finch, Grand Haven, Mich., 23 cts. Hubbell & Skeldon, Saginaw, Mich., 23½ cts.; Stang & Gillmore, Lorain, O., 24¼ cts.——For dredging the west channel of the Saginaw river, along West Bay City, Mich., proposals opened June 2: Hubbell & Skeldon, 30 cts. per cu. yd., Carkin, Stickney & Cram, 37½ ctr.

Scales.—The following proposals for track and wagon scales were opened recently by J. W. JACOBS, A. Q. M., U. S. A., Atlanta, Ga.: Buck & Gregg Hardware Co., Atlanta, Ga., ("Buffalo") $2,675; Page, Dennis & Co., New York. ("Howe") $2,735; Fairbanks & Co., New York, ("Fairbanks") $2,815.75. The prices included both scales, and the high price of the bids were due to the requirements of the specifications. The specifications called for scales manufactured by the Fairbanks, Howe or Buffalo scale company, set up complete, including foundations, etc. The wagon scale to have a platform 14 ft. 2 ins. by 8 ft. 2 ins., and a capacity of 5 tons: the track scale to have a platform 34 ft. long and a capacity of 50 tons. The foundation to be of Georgia granite hammer dressed masonry; the side of the pit above the foundation to be of brick.

Sewers.—Proposals for the construction of sewers at Amsterdam, N. Y., were received from the following firms: the work being in 5 districts: Joseph N. Drew, Buffalo; Sherman & McDonough, West Troy; Stanton & Doyle, Cohoes; D. W. McConnell & Co., Buffalo; John S. Charles, Amsterdam, and Michael Sullivan, Little Falls; David Mathias, Amsterdam; Rider & Dougherty, Yonkers; Brown & Buckley, Mohawk; Franklin A. Snow, Providence, R. I.; (all these were for the 5 districts); Patrick Shannon, Amsterdam, (2nd district); Benjamin Van Vranken, Schenectady, (2nd district); John J. Everson, Akron, O., (5th and 6th districts).

Dredging.—The following proposals for dredging at Toledo harbor were opened May 31 by Major L. COOPER OVERMAN, U. S. Engineer Office, Cleveland, O.: Geo. Talbot, Buffalo, N. Y., 20 cts. per cu. yd. for all the dredging, 21 cts. for a part of the dredging; measured in the scow; L. P. & J. A. Smith, Cleveland, O., 24 cts., 25 cts.; Stang & Gillmore, Lorain, O., 25 cts., 23 cts.: for all the dredging; Carkin, Stickney & Cram, East Saginaw, Mich., 23½ cts.; John M. Eley & L. J. Seek, Toledo, O., 24¾ cts.; Chas. F. Dunbar, Buffalo, N. Y., 27 cts.; Chas. B Crane, Chicago, Ill., 27 cts.: for a part of the dredging; Edwin H. French, Fulton, N. Y., 22½ cts.; Wm. St. John, Toledo, O., 24 cts.; Dodge & Petrie, Chicago, Ill., 33 cts.

Sewer Work.—The following proposals were opened recently by W. ELLWOOD WYNNE, Corporation Clerk of Avondale, O., at Cincinnati, O., for sewer work at Avondale: Main sewers; Barton & Joute, $7,954.75; Thos. J. Peter, $9,259.05; R. J. O'Maley, $18,965, Lateral sewers, Barton & Joute, $2,928.20; Thos. J. Peter, $3,805. Manhole covers; Francis Fritsch, 2¼ cts. per pound; Eureka Foundry Co, 2¼ cts.; Haefinghoff & Lane, 2½ cts.; Globe Foundry, 2¾ cts. Contract awarded to Francis Fritsch. Sewer pipe, Blackmer & Post, St. Louis, Mo., 65 per cent. off list price; J. V. Nicolai, R. E. McCracken, L. H. McCammon, W. H. Seymour, H. J. Conkling, Ervin Lime Co. and John Mueller, all bid 45 per cent. off list price.

Steam Heat for Lancaster, Pa.—Dr. R. S. BISHOP, President of the American District Steam Co. (Holly combination system), is about organizing a company to introduce steam heat. He proposes a stock company, with $100,000 capital, and subscriptions are now being taken. This system is in use in Lockport, N. Y.; Springfield, Mass., and Denver, Col. Steam-heating is in use in New York City, and in a number of Pennsylvania towns.

Street Work.—The following proposals for work on Baymiller street were opened recently by the Board of Public Affairs, Cincinnati, O.:

		G. Eyerman & Co.	F. Kirchner & Co.	Folz, Ashman & Co.
Curb, 4-in.	per lin. ft.	1·12	1·00	1·15
Curb, 5-in.	" " "	1·15	1·35	1·15
Curb reset, 4-in..	" " "	.05	.04	.05
Curb reset, 5-in..	" " "	.05	.05	.05
Crossings	" " "	1·15	1·15	1·05
Grading.....	" cu. yd.	.40	.30	.35
Granite	" sq. yd.	3 40	3.40	3.45
Hyd. cement.....	" cu. yd.	4·00	4.20	4.45
Rolling.....	" sq. yd.	.04	.05	.05

For work on Third street, the bidders were Wm. Hussey and G. Eyerman & Co. For work, with asphalt paving, on Seventh street, the only bid was from the Warren-Scharf Asphalt Paving Co.; the item for asphalt paving was $2.75 per sq. yd.

Grading and Sewers.—The following proposals were opened May 28, at Duluth, Minn., by JAMES FOWLER, City Engineer: Grading First street; John S. Wolfe & Co., $228,674 with Kettle River sandstone curb, $236,474 with granite curb (Granite accepted). Grading Third street; John S. Wolfe & Co., $198,650.50 with sandstone curb, $200,006.50 with granite curb; W. H. Fitzpatrick, $210,805.80, $212,387.80; James Baxter & Co., $242,-989.16, $243,893.16; D. A. Duncan, (granite) $233,690. (Sandstone accepted).——Sewer on First street; John S. Wolfe & Co., $48,078.80. Sewer on Third street; W. H. Fitzpatrick, $11,558.70; John S. Wolfe & Co., $11,562.80; James Baxter & Co., $11,870.30; D. A. Duncan, $12,986.80. The contracts were all awarded to John S. Wolfe & Co.

The contract prices were as follows: Grading: earth excavation, 37 and 60 cts. per cu. yd.; rock excavation, $1.65 and $1.75 per cu. yd.; earth borrow 55 and 58 cts. per cu. yd.; gravel $1.30 per cu. yd.; wooden cross walks, $20; wooden gutters, $18; wooden sidewalks, 53 cts. per lin. ft.; wooden bridge, $20 per ft.; Telford pavement, $1 per sq. yd.; sewer pipe, $2.25 per ft.; culvert pipe, $2.20 per ft.; stone gutters, $3 per sq. yd.; stone crosswalks, $95 each; sewer brick, $19 and $19.50 per 1,000; rubble masonry, $4 and $4.75 per cu. yd; brown stone, $20 per cu. yd.; stone paving, $1.35 and $1.45 per sq. yd.; granite curb, $1.30 per ft.; sandstone curb, $1 per ft.; timber, $18 per 1,000 ft. B. M.

Sewer work; earth excavation, 85 cts. per cu. yd.; rock excavation, $5.25 per cu. yd.; sewer pipe, 8-in., 30 cts. per ft.; 9-in., 35 cts.; 10-in., 40 cts.; 12-in., 55 and 65 cts.; 15-in., 85 cts.; 18-in., $1.25; 20-in., $1.50; 21-in., $2; flushing tanks, $95 each; manholes, $75 each; lamp holes, $15 each; inlets to curb line, $2.80 each.

Bridges, Canals, Etc.

Bridge Notes.—Wareham, Mass. The Old Colony R. R. Co. will build 3 bridges.——Boston, Mass. The survey for the new bridge across the Charles river between West Chester park and Cambridge are in progress; the bridge will be of iron, on masonry piers, and there will be a draw operated by steam.——Troy, N. Y. The Contracting Board will erect an iron bridge over the Poestenkill at Hill street at a cost of $7,000 or $8,000.——Washington, D. C. A new bridge will replace the old structure over the Eastern branch at Pennsylvania and Kentucky avenues, into Maryland; it will be 2,235 ft. long, and will consist of iron trusses and iron trestle work. The plans were prepared by Col. PETER C. HAINS, U. S. Engineer Corps.——Covington, Ky. One of the caissons for the Huntington bridge of the Chesapeake & Ohio R. R. across the Ohio river, was launched June 3.——London Mills, Ill. The London Mills Iron Bridge Manufacturing Co. has been incorporated by A. J. HARLAN, D. H. SWARTZ and S. MCFARLAND; capital stock, $20,000.——Minneapolis, Minn. City Engineer RINKER's amended plans for the Franklin avenue bridge over the Mississippi river have been adopted; there will be 1 through span of 302 ft. and 3 deck spans of 176 ft. each; the headway will be 80 ft. The cost is estimated at $137,942: substructure, $58,752; superstructure, $79,190.——Burlington, Ia. The firm of Crawford & Son has been incorporated to construct iron bridges; J. W. CRAWFORD, of Crawfordsville, is at the head of the company, and has the western agency for the Pittsburg Bridge Co.——Buena Vista, Col. A wagon bridge will be built across the Arkansas river by the Midland R. R. Co.; the town will build the west approach.——Templeton, Cal. The piers of the Salina river bridge are erected and the bridge will soon be completed.

Continued on page XIV.